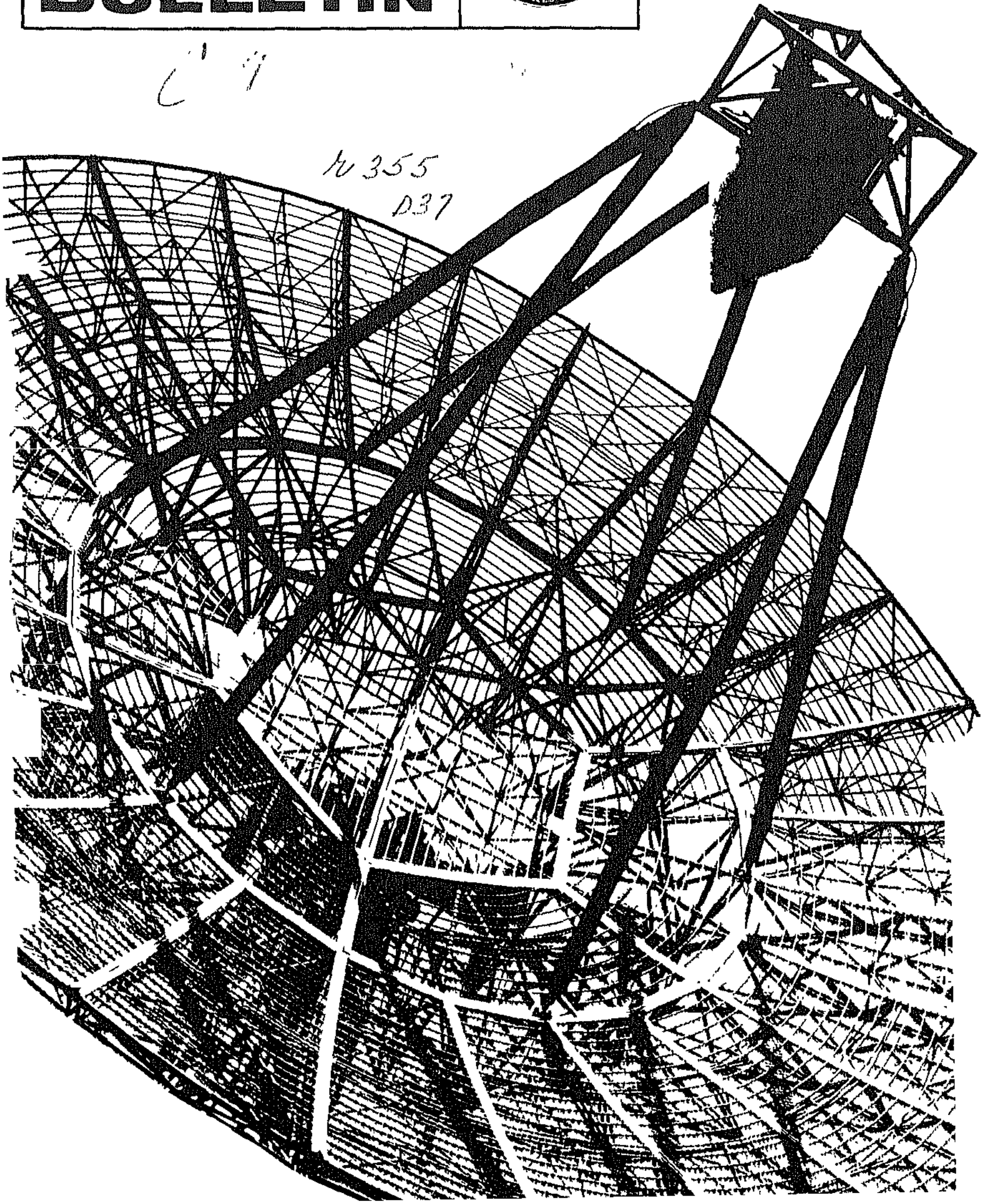
DEFENSE INDUSTRY BULLETIN

January 1969



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Suggestions from industry [illegible] for [illegible] issues are welcome and should be forwarded to the Editor at the address shown below.

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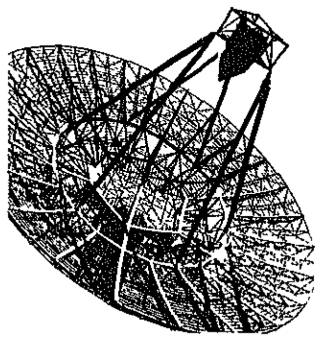


Ear to the sky. Permanent, semipermanent and transportable antennas will listen to satellites relay messages around the world. Article is on page 7.

Uniform Policy and Guidance Established for Configuration Management

Edward J. Engoron
Albert L. Jackson Jr.

The aim of configuration management, like the larger processes of systems engineering management and logistics management that it supports and serves, is to enable and facilitate the timely conversion of a military need or opportunity to hardware that will perform as required, and that can be produced, operated and supported as planned.

This article is a summary of configuration management as it has been established by the newly issued DOD Directive 5010.19, "Configuration Management," July 17, 1968; and implemented through DOD Instruction 5010.21, "Configuration Management Implementation Guidance," Aug. 6, 1968. This configuration management policy will be applied to new contracts by means of four Military Standards and a specification which were developed concurrently with the policy documents.

What is Configuration?

The configuration of an item (or product) is a collection of its descriptive and governing characteristics, which can be expressed in functional terms, *i.e.*, what performance the item is expected to achieve; and in physical terms, *i.e.*, what the item should look like and consist of when it is built. In practice, an item being developed is described and governed primarily by its intended functional characteristics (with some physical characteristics usually being specified). Following development, however, an item being produced for inventory is ordinarily described and governed by its physical characteristics.

What Is Configuration Management?

Configuration management is a discipline which integrates the technical and administrative actions of identifying and documenting the functional and physical characteristics of an item during its life cycle, controlling changes proposed to these characteristics, and providing information on the status of change actions. Configuration management is thus the means through which the integrity and continuity of the design, engineering and cost tradeoff decisions made on technical performance, producibility, operability and supportability are recorded, communicated and controlled by program and functional managers.

Background

Prior to 1962, the management of systems and equipment characteristics—or configuration—was confined almost completely to controlling changes to production hardware via the approval of engineering change proposals (ECPs). Careful technical and management attention usually was given only to major design and engineering changes because of their visibility and impact on technical performance, and on program cost and schedule. However, other important problems were resulting from ECPs but were not given comparable attention because they were not so obvious, and because they did not impact quickly or directly on program objectives.

Configuration-related problems were most evident in programs for the production and deployment of large, complex systems. This led the Air Force, in 1962, to establish for internal use the first comprehensive policy and procedural guidance on configuration management (Air Force Systems Command Manual 375–1). In 1964, this manual was revised to incorporate the experience gained in its use, to improve control of item configuration during the development phase (since achieving approved item characteristics was the basis for program approval), and to provide exhibits for contractual application in development and production. Similar guidance on configuration management was issued by the Army in 1965 and by the Navy in 1967.

Early in 1964, the Logistics Management Institute (LMI) reported on its study of engineering change control practices. In addition to the finding that ECPs accounted for 20 percent of the dollar growth and 80 percent of all change actions (on the several large programs analyzed), LMI concluded that increased program costs were caused by failure to consider all the factors in making change decisions, by lack of uniformity in DOD change practices, and by procedures in use failing to assure prompt change processing, decision and implementation.

Later in 1964, at the DOD Conference on Technical Data Management, the Panel on Configuration Control/Change Control Documentation concluded that configuration management was essential to the successful accomplishment of major DOD programs, and that a large spectrum

velopment and production activi- "depend heavily upon a clearly ed and strongly supported con- ation management system."

June 1964, the Assistant Secre- of Defense (Installations and stics) and the Director of De- Research and Engineering joint- itiated a comprehensive effort, the participation of the Mili- Departments and the Defense cies, to establish more effective iques and to develop uniform es, practices and contractual nents for use in managing sys- and equipment configuration ghout the life cycle phases of opment, production, operation support. This joint effort, which led regular collaboration with all nts of industry via the Defense stry Advisory Council (DIAC) he Council of Defense and Space try Associations (CODSIA), has ced the policies and procedures sary for effective configuration gement. Many of these were ed for use prior to formal issue policies. Emphasis now will be l on their implementation, and ablishing the indoctrination and ng programs that have been ed.

What Kinds of Problems Were There?

he total cost and other conse- es of ECPs were not known at ime of approval. Many ECPs approvals evaluated only the e itself. Little assessment was of the modification kits and spares that would have to be red and distributed (sometimes ny locations); whether test, sup- or training equipment would o be modified; the extent of re- to operating and maintenance ces, workloads, manuals, etc. the "advantages" of the change stressed and its side effects were nown or presented, changes of nal value were often approved. roposed changes were not eval- promptly. Other than changes rect hazardous conditions, de- of ECPs were frequently de- . If a change was subsequently d, the delay caused larger ret- rograms, normally accompanied her costs.

pproved changes were not in- ated promptly. Once approved, s to items *in production* were lly made within a reasonable time. However, changes to items *in operational use* frequently extended over long periods of time, thus deny- ing the user of the item the benefit on which the change was based. More- over, operation, maintenance and logistic support of the item all were made more difficult because of the "mixed inventory" that resulted.

• **Responsibility and authority for managing configuration was diluted.** Frequently, there was no single indi- vidual fully responsible and author- ized to make and enforce decisions on item configuration. The prevalence of committee type action, requiring at least a consensus and sometimes unanimity, caused undesirable com- promises and delays in configuration decisions. Additionally, it was dif- ficult to retain the configuration commonality that made possible effec- tive and economical production and cross-Service logistics support of items procured for use by more than one Service.

• **Specifications were inadequate for configuration needs.** Guidance for the preparation of specifications was oriented to the procurement of stand- ard production items, and thus was not adequate for the preparation of specifications to be used in the devel- opment and follow-on production of complex systems and major equipment. Methods were not provided for as- suring that specifications to be used during development would be perform- ance oriented, *i.e.*, that they would describe functional characteristics of items. Consequently, important func- tional characteristics often were omit- ted or not adequately described and quantified, while unnecessary design constraints, *e.g.*, physical characteris- tics, were prematurely specified.

• **Verified technical documentation was lacking when needed.** Policies and procedures in use did not assure that configuration technical documen- tation was accurate, or that it matched the item it described. Also, this data frequently was not available at the time it was needed for change- related design and manufacture oper- ations, for quality assurance and ac- ceptance inspection and, especially, for operational, maintenance and logistic support purposes.

• **The configuration of items in use was not known.** Procedures were not effective for identifying the approved configuration of items, or for deter- mining the status of changes that had been approved or accomplished. Thus real knowledge of the configura- tion of items in use often was not available, making the maintenance and logistic support of the item diffi- cult and more costly to perform. In some cases, the actual configuration of items, when deployed, mismatched with their operational interfaces, with serious effect on operational readi- ness.

• **Configuration practices caused misunderstandings and delays.** There were incompatibilities among and within the Military Departments in the configuration areas of policy, technical documentation, item identi- fication (numbering), terminology, and ECP procedures. In addition to causing program misunderstandings and delays within DOD, this lack of uniformity was particularly burden- some for the large number of contrac- tors doing business with more than one DOD customer.

What Is the Gain to the Parties Concerned?

DOD and industry both will benefit from the new configuration manage- ment discipline since it was developed with a full understanding of the need for practical solutions to the prob- lems being experienced, and for an effective means of preventing their oc- currence in the future.

Edward J. Engoron is Deputy As- sistant Director (Engineering Man- agement) in the Office of the Director, Defense Research and En- gineering. He has served in several key positions with responsibility for developing maintenance engineering policies at the Office of the Secretary of Defense level since 1954. Prior to that he served as Deputy Director of Maintenance Engineering in Head- quarters, U. S. Air Force.

The responsibility and authority for configuration management is now established clearly for all items, whether intended for single or joint use by the Military Departments and Defense Agencies. DOD and industry will know who to look to for decisions and information. When configuration managers tailor the policies, procedures and techniques that have been established to the complexity and life-cycle phase of the particular item to be managed, we can expect:

• Maximum latitude during item design and development, yet timely depth of configuration control needed for production and logistic support purposes.

• Earlier and accurate definition, documentation and tracking of functional and physical characteristics of items.

• Availability of verified technical data at the time and for the purposes needed.

• Quicker approval and implementation of worthwhile ECPs, waivers and deviations.

• Increased operational effectiveness of deployed items, and improved logistic support at reduced total cost.

• Significant reduction in the number and variety of data, forms and reports for managing item configuration.

Albert L. Jackson Jr. serves as Staff Assistant to the Assistant Director (Engineering Management) in the Office of the Director, Defense Research and Engineering. He is Vice Chairman of the DOD Steering Group on Configuration Management. He has responsibilities for policy, systems and procedures related to management of DOD engineering practices, including configuration management.

What Are the Essential Functions of Configuration Management?

While the scope and detail of configuration management is tailored to a particular item's complexity, life-cycle phase and quantity, these four functions are essential to managing an item's configuration:

• Identification and documentation.
• Audit.
• Status Accounting.
• Change Control.

The *identification and documentation* function is to assure the systematic determination of all the technical documentation (specifications, drawings and associated lists) needed to describe the functional and physical characteristics of items designated for configuration management; and also to assure that these documents are current, approved and available for use by the time needed.

The *audit* function is the comparing of an item with its current approved configuration as described in its technical documentation. Two kinds of audits are made: functional and physical. A functional audit primarily involves a review of an item's test data to verify that it will perform as intended, *i.e.*, that its functional characteristics satisfy those specified in the item's technical documentation. For items developed at government expense, a functional audit is a prerequisite to acceptance of the development effort. A physical audit involves the matching of an "as built" version of an item with its current approved technical documentation to assure that the documentation is complete and suitable for use in follow-on production, for accepting items produced, and for operational, maintenance and logistic support purposes.

Status accounting is the means through which actions affecting an item's configuration are recorded, and are reported to program and functional managers concerned. The accounting function identifies an item's initial approved configuration, then continuously tracks changes proposed to that configuration as well as the priority, schedule and progress of changes that are approved. Additionally, current information is provided on all other aspects of a change to a configuration item, *e.g.*, other hardware affected, operating and technical manual revisions, modification kits and spares requirements, specification and drawing updating, etc.

Change control is the most visible aspect of configuration management since the people in this activity evaluate and approve or disapprove ECPs, as well as requests for deviation or waiver of technical requirements. The purpose of change control is to prevent unnecessary or marginal changes while expediting the approval and implementation of the worthwhile ones, *i.e.*, those that are necessary or promise significant benefit to the Government. Such changes are those which will:

• Correct deficiencies.
• Significantly improve operational effectiveness or reduce logistic support requirements.
• Result in substantial life-cycle cost saving.
• Prevent slippage in an approved production schedule.

In addition to change decision making, change control includes the equally important functions of setting change priorities, *i.e.*, emergency, urgent, or routine, and of assuring that necessary instructions and funding authorizations are issued promptly for approved changes.

What Items Are Configuration Managed?

The selection of items to be configuration managed is determined by the need of the Government to control an item's inherent characteristics, or to control that item's interface with other items. Thus configuration managed items may be large or small, complex or simple.

In a missile system, for example, the missile itself, its guidance system, and its operational computer program each would be configuration items, and would be so identified in a contract (all configuration items are). Such a complex system may well require a highly organized configuration management effort to assure that the results of the systems engineering—the technical performance and design requirements—are systematically identified and documented, audited and controlled. In contrast, an item such as an electrical test meter (which may be procured for use in several systems) may require nothing more than specification control and acceptance inspection prior to entering the inventory.

A special case exists for items that are developed at private expense

and procured "off the shelf." A decision to use a privately developed item recognizes that government control of the item's characteristics can and will be limited to "form, fit and function." This does not prevent the Government from testing (or examining test data) to assure that the item is satisfactory for its intended use, or from obtaining the technical data needed to service and repair the item.

When Does Configuration Management Begin and End?

For items developed at government expense, formal configuration management begins when the items are approved for engineering or operational systems development (contract definition, when used). If contract definition is conducted on an item, the configuration management of its sub-items is deferred until the definition is completed.

For privately developed items, configuration management begins when procurement for inventory is initiated. Whether developed at government or private expense, the configuration of items is managed until they are removed from the operational inventory, including operational reserve storage.

Who Is Responsible for Configuration Management?

A single individual in a DOD component (Military Department or Defense Agency) is responsible and authorized to manage each configuration item. Where a system/project manager is assigned for the development or production of an item, he is responsible also for managing that item's configuration. In other cases, an individual by name, or the head of a functional office, is responsible for managing the configuration of designated items.

Where more than one DOD component is involved in the development, production, operation, or support of an item, one designated component is responsible for developing, negotiating, documenting and implementing plans and agreements for managing the item's configuration.

What New Aids Does the Configuration Manager Have?

- Authoritative policy and implementation guidance (DOD Directive 5010.19 and DOD Instruction 5010.-21).
- Criteria for selecting specification types for describing item functional and physical characteristics, and guidance for in-house or contractual preparation of these specifications (MIL-S-83490 and MIL-STD-490).
- Criteria and uniform practices for proposing, justifying and approving engineering changes, waivers and deviations and methods for their implementation (MIL-STD-480 and MIL-STD-481).
- A comprehensive listing of standard data elements for tailoring the selection of information to be recorded and reported on item configuration status (MIL-STD-482).
- Uniform terminology and definitions for configuration management (MIL-STD-480).

The new aids impact to varying degrees on a wide variety of configuration management policies, practices and procedures now in use. For example, at least 23 DOD component documents have been identified as providing configuration management guidance to their activities for internal use. Some of these documents may be consolidated or eliminated; the remainder will require some revision to reflect the improvements intended.

For contractual application, approximately 70 DOD component documents have been identified for use. Of these documents, 29 will no longer be authorized for use on new contracts; the remainder will be revised to be compatible with the new policies and practices.

Equally important, a basis has now been established to assure that any existing or new configuration management documents to be applied on contracts will be authorized by the Office of the Secretary of Defense prior to use.

In summary, the concept and principles of configuration management are not new. Primarily, what DOD has done, with considerable help from industry, is to identify, assess, improve and codify the logic and practice of configuration management, and to integrate it with the systems engineering management and logistics management processes over the entire life cycle of systems and equipment. Rational procedures and a discipline have been developed for this purpose. The payoff, however, is that these techniques will improve our ability to achieve the operational performance and readiness we need at the lowest total cost.

Modified Wind Tunnel Improves USAF Jet Test Capability

Techniques used by the Air Force in testing jet engines at simulated ultra high altitudes have been advanced with the installation of a liquified gas (cryogenic) cooling system in the large transonic wind tunnel at the Arnold Engineering Development Center in Tennessee.

Prior to the modification, valid flight conditions could only be simulated at altitudes less than 30,000 feet through a Mach number range 0.2 to 1.2 (130–780 m.p.h.). Altitude range has been extended to 90,000 feet with the new system.

Temperature conditions in the Arnold wind tunnel are normally controlled by a water-fed cooler system which limits temperature-matching to low altitude figures.

Until recently, the limited temperature-matching capability of the tunnel was not a handicap. True temperature matching was not critical in most conventional low-speed aerodynamic tests, and air-breathing propulsion system design was advanced enough to provide good performance without extensive test requirements.

However, testing of advanced air breathing engines requires temperature matching over a higher altitude range than was available in the past.

Preliminary studies indicated that installation of a permanent conventional refrigeration system would cost more than $4 million. However, engineers of ARO, Inc., contract operator of the Arnold Center, designed a system which cost only $930,000 and used about $800,000 worth of surplus Air Force equipment.

The improved capability was attained by modifying the water-fed cooler to accept liquid-nitrogen cooled mineral spirits. The airflow is further cooled by liquid air, a mixture of liquid oxygen and liquid nitrogen, which is directly sprayed into the flow from a hundred nozzles on two spray header manifolds just upstream of the test section.

The liquid air spray system was designed for easy installation and removal, and the heat exchanger can be rapidly converted to accept either water or the chilled mineral spirits.

Improved Performance Is Goal of Multiple Incentive Contracts

Francis J. Hines

The concept of performance incentives in government contracts is not new. It dates as far back as 1909, when the Wright Brothers signed a contract with the U. S. Army for its first aircraft. The details of the contract were quite specific: Carry two passengers weighing a total of 350 pounds non-stop for 125 miles at an average speed of 40 miles per hour over a 6-mile course, be assembled in 1 hour, transportable in Army wagons and able to take off and land in any unprepared terrain. There were other stipulations which indicated that the Government was being very precise about what it expected the contractor to produce. For all this, the Government would pay $25,000.

To make the work a little more interesting, Uncle Sam and the Wright Brothers agreed on a performance-incentive clause. For every mile over 40 the flying machine could average, the contractor would receive an additional 10 percent or $2,500. For every mile per hour under 40, the Government would deduct 10 percent. Under 36 miles per hour, the aircraft would be rejected.

The aircraft whizzed along at over 42 miles per hour, and the Wright Brothers collected a fee of $5,000 in addition to the contract cost of $25,000.

Since then, incentive measurements have become far more sophisticated. Today, a multiple-incentive contract's purpose might be to motivate a contractor to:

- Produce a product or service with significantly advanced performance goals.
- Meet or improve on contract schedules.
- Control and reduce costs.
- Complete the contract within a weighted combination of some or all of these objectives.

The contractor's risk is the potential addition or reduction of his fee (profit), based upon previously established measurements of his ability to control costs, performance and delivery. If the contractor is able to excel in these pre-established incentive measurements, the Government benefits by receiving the maximum level of weapon system effectiveness for the dollars expended. Of course, to be effective, a multiple-incentive contract must communicate the Government's objectives to the contractor. At the same time, it must motivate the contractor to achieve these objectives.

One of the Government's major concerns has been to determine, before contract completion, exactly how the contractor will interpret and act on the incentive matrix. This concern caused an association between the U. S. Air Force Academy and the Pricing Division of the Air Force Systems Command's Space and Missile Systems Organization (SAMSO) in Los Angeles. A research team, made up of members of the faculty and cadet wing of the Academy, was formed in 1963 to determine whether mathematical techniques could be developed to help analyze multiple-incentive contracts. For four years, this team conducted research part-time during the academic year and full-time during the summer. This research led to computer techniques which assist in evaluating existing or prepared incentive matrices and in structuring desired incentive matrices.

One of these programs, *evaluation*, produces a graphic tool which helps analyze both Requests for Proposals (RFPs) and existing contracts. For example, the cost-versus-cost incentive fee (profit) curve and the performance-versus-performance incentive fee (profit) curve are combined via the computer to obtain a set of cost-versus-performance tradeoff curves. Each curve depicts the various combinations of cost and performance that will result in the same fee. Analysis of these tradeoff or constant-fee curves provides a simple check to see if the proposed incentive matrix reflects the desired balance of emphasis among the incentive elements. Cost-performance nomographs are also generated as a further visual aid to tradeoff analysis. With these nomographs, a straight-edge can be used to determine the fee for a given cost-performance outcome.

Francis J. Hines is Chief Division, Procurement and P Office, Space and Missile Sy ganization. A native of Colo., Mr. Hines atten University of Colorado and versity of Denver. The D ered Program Office for I and Structuring Multiple Contracts (POESMIC) quartered at SAMSO u direction.

The second program, *structuring*, assists in developing an incentive matrix which reflects the Government's objectives. This program has two steps. The first, performance ordering, is a graphic, tabular tool which permits a check of the values of individual performance elements to ensure that they have been properly structured and weighted. To assist in this check, performance-versus-performance point curves are generated by the computer for each incentive performance element. These curves indicate the contribution of each of the individual performance elements to the overall performance rating. Performance tables, cost-performance equivalence tables, and performance nomographs are also generated. The performance tables express several possible combinations of the performance elements and their resultant aggregate values, and permit analysis of performance-element weights. Also, they define acceptable tradeoffs among the individual elements. Cost-performance equivalence tables add additional visibility by reflecting the performance incentive fee associated with each level of performance in the table, and the equivalent cost in development dollars which would offset the performance fee to be earned for the increased performance. Again, the nomographs permit various element performance levels to be connected to arrive at the point system which each unique combination within the performance matrix represents.

The second step in structuring requires answers to the following questions:

- What is the value (worth) to the Government of increasing technical performance from minimum to par performance?
- What is the value (worth) to the Government of increasing technical performance from par to maximum performance?

Answers to these value questions must come from the government buying office. There are a number of methods for determining these values. Two methods that have been researched and documented are the Cost-Benefit Method and the Cost-Performance Correlation Method. The former uses a systems analysis approach to determine the procurement and life-cycle operating cost savings to the Government for increases in technical performance. These projected government savings in procurement and operating costs are shared with the contractor th performance incentives, jus savings in development costs shared via the cost-incentive ar ment. The Cost-Performance (lation Method uses subjective ment to arrive at and then che answers to the value questions.

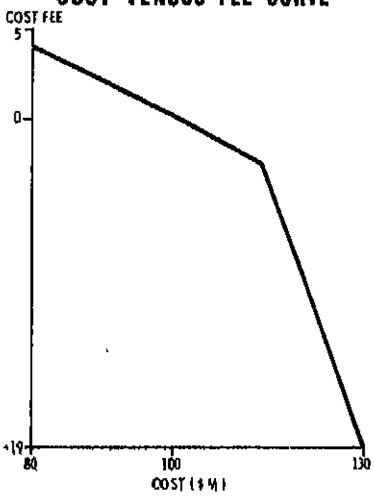
These values are combined wi cost-versus-cost incentive fee (curve and the aggregate pe ance-versus-performance incenti (profit) curve, to computer-ge (as with the evaluation progra set of cost-versus-performance off curves that portray the goa sired by the buying office. Once cost-performance nomographs generated as a further visual augment the tradeoff curve an

These techniques were so pron that the Office of the Assistant tary of Defense (Installation Logistics) asked the Air Force the DOD executive agent. Th Force placed the responsibility the Pricing Division of SAMSO. division's Program Office for Ev ing and Structuring Multiple tive Contracts (POESMIC) o officially in Los Angeles on Ap 1968.

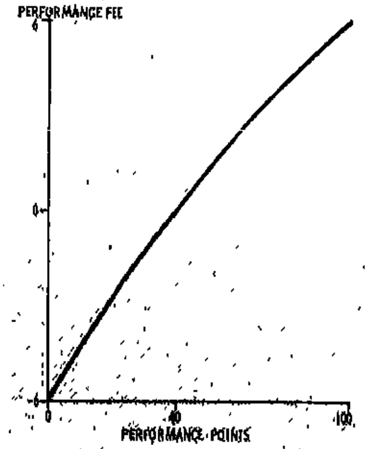
POESMIC evaluates, stru and analyzes existing and pro multiple-incentive contracts fo Army, Navy, Air Force and th tional Aeronautics and Space ministration. It also gives tec advice to program users and ducts further research in adv incentive structuring and related jects.

(*Continued on page 24*)

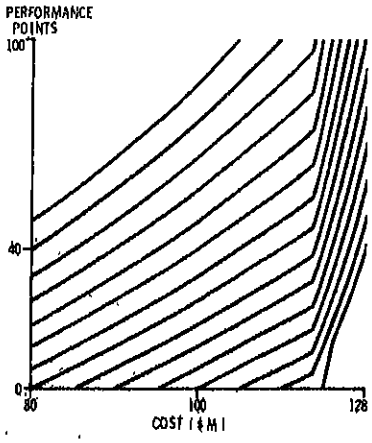
COST VERSUS FEE CURVE



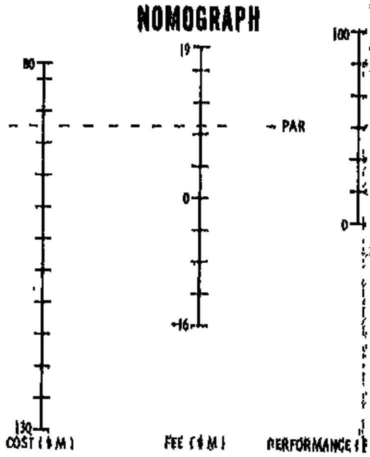
PERFORMANCE VERSUS FEE CURVE



TRADEOFF CURVES



NOMOGRAPH



Defense Satellite Communications—Beginning, Progress, Future

Lieutenant General Richard P. Klocko, USAF

In 1950 the Encyclopedia Americana devoted only nine lines of print to satellites—all the information pertained to the astronomical bodies associated with the heavenly planets and Earth was credited with having only one. Over the span of not quite a decade, the technology of a modern, dynamic world has produced a new meaning. The satellite has taken on a complex and varied interpretation, not only in communications but in many scientific fields. In addition, the number of satellites surrounding the Earth has multiplied in significant numbers without regard to any fixed mathematical progression.

Efforts in communications by satellite began in earnest with the commercial "Early Bird" in April 1965, followed by the initial launch of the defense system in June 1966. Since that time attention has been applied not only on improving the capabilities of the initial system, but also to the needs of the future and the next satellite communications generation that is inevitably to follow.

During the summer of 1967, the Defense Communications Agency (DCA) was planning the communications advances that would be achieved by implementing an advanced operational satellite communications system. At that time, although the initial phase of the defense communications satellite project was nearing completion with notable results, it was recognized that this phase provided a limited system. The satellites are drifting and, consequently, do not remain mutually visible to a pair of earth terminals for long periods. Since significant gaps occasionally occur between satellites, long periods when satellite links are not available also occur. Additionally, current satellites are low powered and limited in bandwidth. Earth terminals, built as research and development models, are limited in capability and operational reliability. These limitations combine to provide very real boundaries to the utilization of the system. Only a new system, capitalizing on the latest advancements in technology, can overcome these limits.

With this goal in view, DCA, as the responsible agency in the Defense Department, began in 1965 to plan for a second generation Defense Communications Satellite Program under the guidance of the Office of the Director, Defense Research and Engineering.

After many months of mutually beneficial discussions at the Secretary of Defense level regarding an advanced system, on June 18, 1968, the Defense Department announced its decision to proceed with an Advanced Satellite Communications System.

This article discusses the new operational initial system, the recently approved Phase II and, finally, a look into the future for the Defense Satellite Communications System.

Before going too deeply into evaluation of the system, I should like briefly to address the question, "Why do we need a Defense Satellite Communications System?" As a matter of national policy, the need for a separate Defense Satellite Communications System is recognized by the inclusion of provisions within the Communications Satellite Act of 1962 that permits the creation of " . . . additional communications satellite systems, if required to meet unique governmental needs or if otherwise required in the national interest." This policy was reiterated by the President in his annual report to Congress on Feb. 15, 1965.

Consequently, a separate defense system is to provide features that are most essential to the military—features that differentiate the defense from the commercial systems—such as:

- Flexibility for rapid extension of service to new areas and the ability to reconfigure the system.
- Increased survivability from both electronic and physical attack.
- Reliability/availability to assure rapid special service.
- Security.

The Defense Department also needs a system to provide a capability to process types of communications, such as digital data and graphics, that cannot be processed by commercial systems, either for reasons of economy or security.

Initial Defense Communications Satellite Project (IDCSP)

At the present time, DOD has a rudimentary system—IDCSP—in use. It bears the same resemblance to the Phase II system as the Model-T does to the present automobile. The initial system is employed to fulfill operational Defense Communications System (DCS) missions on eight separate trunks. The DCS uses four types of ground terminals: the fixed earth terminal with 60-foot dish antenna, the medium transportable terminal with 40-foot antenna, the small transportable terminal with 18-foot antenna, and the small shipboard terminal with 6-foot antenna. There are currently three types of channel capacities: 11 voice channels on 3 trunks, 5 voice channels on 2 trunks, and single channel capacities on the remaining trunks. Satellite trunks are generally capable of passing the same type of communications traffic as are cable, tropospheric scatter, or microwave facilities.

Twenty-six standard satellites have been successfully launched for this system and placed in near-synchronous altitude equatorial orbit (18,200 nautical miles).

If any system may so be counted, this initial effort can be aptly classed as an inter-Service success story of the first magnitude. Under DCA's overall management, the Army supervised the development and installation of two types of earth terminals: the Hughes-made medium transportable and the Radiation Co.-made small transportable. The Navy supervised development and installation of Hughes-built shipboard terminals. The Air Force supervised development and emplacement of the Philco-made satellite space portion.

From 1966 until mid-1968, most of the system components were built, tested, emplaced, calibrated and, where necessary, modified and beefed up. All 36 terminals have come off the assembly line but a few have yet to be deployed. Personnel have been trained to perform the multitude of tasks associated with the system operations, maintenance and control. As any reader might guess, an effort of this size, involving considerable amounts of manpower and financial military and industrial resources, while successful in the long run, did not reach fruition trouble-free. Like most new complicated systems under development, it had its moments—or more accurately its months—of anguish and disappointment. Basically, however, it has fulfilled its purpose.

During the two years that elapsed between June 1966 and June 1968, the Air Force orbited 26 communications satellites; all but one have performed up to DCA standards. Five Titan IIIC launches were involved in all, with four of the five being successful.

Now circling the Earth at about 18,200 nautical miles altitude, all 26 communications satellites were injected into an equatorial, near-synchronous orbit. They drift in an easterly direction at a rate relative to Earth of about 24 degrees longitude a day. So that the satellites would not "bunch" closely together in space for long periods of time, they were ejected from their dispenser at slightly differing velocities, causing their orbits to be random. Moreover, these satellites were ejected in a manner that imparted perpetual rate of spin of approximately 150 revolutions a minute. Consequently, each satellite remains stabilized so as not to deviate more than plus or minus five degrees from earth's equatorial plane. Each repeater satellite uses two traveling wave tube amplifiers, one to act as an auxiliary backup to serve when the initial one shuts down. They function in the X-band frequency range.

Once orbited, these satellites enabled communicators to vault distances up to 9,000 miles apart between terminals. The more satellites that were added to the ring encircling Earth, the greater became the opportunity of gaining access to them. Thus satellite availability to earth terminals linking South Vietnam with the Pentagon improved from 92 percent in July 1967, when 17 working communications satellites were in orbit, to 96 percent now that 24 working satellites are in orbit.

Beside handling voice and teletype transmissions, the satellites and earth terminals comprising the South Vietnam-Pentagon link have, since late 1967, been successfully used for transmitting high-quality reconnaissance photographs of Vietnam. Moreover, they have experimentally demonstrated the feasibility of transmitting high-speed secure digital data traffic. On at least two separate occasions during late 1967, when certain vital submarine cables were temporarily out of service due to cable breaks, defense satellite circuits were pressed into emergency substitute use for carrying high-priority defense traffic ordinarily transmitted by the cables.

Initially the satellites were conceived to last at least 18 months and hopefully up to three years. Equipped not with batteries that would wear out but with solar array panels for generating their own power, the initial family of satellites was believed capable of squeezing out a few extra years of life beyond the maximum of three. They were endowed with a spare traveling wave tube amplifier to ensure that they would continue repeating communications traffic beamed at them long after the initial amplifier burned out. Despite the fact that, according to latest estimates, they may remain in orbit for as long as 10 years, they are doomed to die after six years of life; their electronic components are destined to switch off automatically at that time. This means that by 1972–73, out of the 26 now in orbit, only those 8 orbited in 1968 will continue to function. This means that, if DOD is to continue satellite communications for carrying unique and vital strategic communications, it behooves us to get something up there to replace them soon—by 1971—because all manner of things are apt to go wrong with them by then.

Follow-on Program to IDCSP

No matter how well the initial satellite system has turned out—and it has turned extremely well for the most part—a follow-on system is needed. There are very good reasons for this, not the least of which is the low 3-watt power output which limits communications capacity of the present satellites, and also the short life span.

Consequently, since 1965, DCA has been planning a follow-on program. Its objective is to furnish the National Command Authority and the Military Services with a future, high-capacity, secure, strategic communications satellite network endowed with an ever higher degree of reliability, flexibility, survivability after an attack, and immunity to enemy jamming. In the interests of economy it is planned, generally speaking upon the existing initial system earth facilities. The principal evolutionary advances are contained in the space elements of the system.

The new satellites will be equipped with earth-coverage antennas, and with steerable narrow-beam antennas. The so-called earth-coverage antennas will direct most of their radiated power toward the Earth so as to cover fairly uniformly that portion of the Earth visible to the satellite. The narrow-beam antennas will direct most of their radiated energy into two very narrow-beam illuminating areas on the earth's surface one to two thousand miles in diameter. The narrow-beam antennas will be steerable so that their beams can be directed towards any selected area of the earth's surface visible to the satellite. Although the satellite will b

mewhat similar to the INTELSAT now under evaluation by the INTELSAT Consortium, the narrow-beam antennas will have greater flexibility than those on INTELSAT 4 meet changing requirements ound the world. It is this uniqueness and flexibility of the Phase II satellite that differentiates the satellite of the future from the present-y military and commercial satellites.

General Objectives of the Phase II Program

Looking closely at the objectives of e Phase II program, it becomes apparent that we are shooting for an panded version of the goals of our iginal system with a few extra vidends added for good measure. hase II must handle securely, and considerable volume, practically very form of electronic communications, including voice, teletype, computerized digital data, and video ansmission. At all costs, Phase II ust still support the National Command Authority promptly—instantaneously if possible.

It is for the National Command Authority that the most vital communications are transmitted, linking world-wide command and control between the White House, the Pentagon, the unified and specified commanders interspersed around the [illegible], and the commanders in the [illegible]. This is a two-way street, with intelligence and sensor data transmitted up the chain of command, and command and control directions passed down. It is important that these [illegible] be served more expeditiously, more reliably, and more securely than today's system can do. We cannot [illegible] will have [illegible] between [illegible] a shower of nuclear-tipped ICBMs is first detected and the time [illegible] will impact. Phase II, moreover, must be more survivable to ground [illegible] air attacks, as well as to enemy jamming, so that command and control information can continue to flow both directions, preferably unimpeded.

Much of what pertains to serving the National Command Authority applies equally to the general improvement needed in the Defense Communications System (DCS). Besides the crucial command and control data, a tremendous volume of data for military logistical and administrative purposes must be communicated through military channels when commercial communications facilities are not available. In this regard, DCA is striving to exploit an optimum "mix," or ratio of resources, whereby the "unique and vital" traffic of the DCS will use military facilities, including the Phase II satellite network, leaving approximately two-thirds of defense traffic to be carried by commercial facilities. The latter also includes satellites, as indicated by the 46 satellite circuits leased by DCA from the international record carriers in the Pacific, and six circuits, with more yet to come, in the Atlantic.

One of the major extra dividends desired from Phase II comes in the area of tactical communications—something people in the strategic communications business shy away from less and less these days. Phase II is expected to lend itself to communications between small portable terminals. Phase II is also expected to facilitate world-wide contingency communications, whereby entire new regions can be swiftly reached by communications in emergency [illegible]. In yet another [illegible] "unique and vital" [illegible], Phase II [illegible] approximately [illegible] of DCS [illegible] landlines, [illegible] facilities [illegible]. HF military communications, incidentally, are expected to decline in the near future as digital data transmissions grow to replace them. Phase II will play no small role in this decline.

Space System

What hardware will comprise the Phase II program? Some information cannot be divulged for security purposes and for the simple reason that some hardware has yet to be worked out in the research and development stage. Indeed, Requests for Proposals are being issued this fiscal year, making any discussion of design features premature.

It can be said that DCS intends to [illegible] a new, higher powered class of synchronous satellites. Orbited at 19,-[illegible] nautical miles altitude, in an easterly direction, several of them distributed around earth's equatorial plane will function as "fixed" stations relative to earth's position. At this stage we have not decided if we will orbit three, four, or more—so much depends upon funding, on the future capabilities of the earth terminals, and on the number of "standby" satellites authorized as replacements.

If anyone thinks there is nothing new about DCA's forthcoming Phase II synchronous satellites, he is right in part. Certainly there is ample precedent: a pair of NASA-produced, DCA-manned satellites named SYNCOMs II and III, which have been orbiting quite synchronously for years. They can continue orbiting until they run out of gas. So there is no question about it, the mechanical aspect of the space platform is happily within the state of the art.

DCA's Phase II synchronous satellites will differ, however, in the quality and quantity of their performance, besides the way in which they perform. Being synchronously positioned and steerable from the ground to help keep them "fixed," Phase II satellites will no longer be subject to periods of "bunching" or of opening holes in the ring, which lessens satellite availability appreciably. Rather, ground terminals will be assured of practically 100 percent accessibility during their allotted time-periods on station.

Whatever number of satellites are orbited synchronously for Phase II, they must be higher powered. They must provide global coverage from 70 degrees south latitude. They must enjoy a relatively long life span. They must contain ample gas for rapid repositioning and maneuvering as re-

quired to support contingency plans. What's more their repeater bandwidth and multiple access capacity must be appreciably increased because not two terminals but scores of terminals will communicate through them simultaneously. To facilitate this, each Phase II satellite will be equipped with two types of antenna: an earth coverage antenna, directing most of its radiated power towards Earth so as to provide uniform coverage to all "visible" terminals; and a narrow-beam antenna that focuses its energy into a narrow beam covering a circle of Earth's surface with diameter of from 1,000 to 2,000 miles.

The narrow-beam antenna must be steerable in order to point it from area to area, as the need dictates. The small portion of earth's surface thus illuminated will consequently receive 100 times more power than this same area would otherwise receive, enabling use of small, portable terminals for contingency as well as strategic purposes. Both antennas would handle hundreds of equivalent voice channels at a time. The concentration of radiated power provided by the narrow beams will enable us to establish these channels to selected transportable small-size earth terminals. This will give the capability, should the urgent need arise, to quickly deploy terminals into new theaters of operation and rapidly establish vital communications into and within the theater to connect the headquarters of major commands or authorities. This capability can be used to supplement and augment the capacity of the DCS in a "day to day" mission mode and also cover contingencies. This will give us a new but very important option. Experience gained in Southeast Asia and elsewhere gave a greater and clearer appreciation of the role that high quality, rapidly established communications channels can play in contingency situations. Although hundreds of millions of dollars have been spent in the procurement, construction, and installation of long-range communications, full communications capacity has often lagged months behind the buildup of forces. The Phase II satellite, with its narrow beam steerable antennas and smaller highly transportable terminals, will hopefully give a capability for rapid buildup of command communications in contingency situations wherever required.

Ground System

Turning to the Phase II terminals, we can now get back down to Earth. But here the ground is more tenuous than solid, because what is known about Phase II terminals is evenly matched by what is not yet known. It is known, for example, that the network of Phase II terminals will use the existing 36 initial system terminals in an upgraded condition. Some of them, the 40-foot and 60-foot ones at least, will be improved to handle up to possibly 60 equivalent voice channels apiece and simultaneously. Furthermore, additional terminals will be bought so that total Phase II terminals will about double the number employed in Phase I. DCA wants to buy more of certain types of initial terminals, and wants to develop an advanced shipboard and an advanced airborne model—the latter for use in the airborne command post. DCA wants to procure a batch of highly transportable terminals to further enhance redeployability in support of contingency operations and survivability.

Now we come to the unknown. It is unknown precisely how many terminals DCA will get, or of what types they will be. It is unknown what modifications to apply to existing terminals, or what modulation and multiplexing subsystems to exploit. These matters, and others, are all under study, with a view to arriving at a versatile, reliable earth terminal network best capable of exploiting the Phase II satellite environment. As procurement plans are firmed up, more information along these lines will be released. Not to be overlooked is the Phase II control system, which is likewise in the study stage, and about which information will also be disseminated when plans become firm.

Future

What of the future? To borrow an old theatrical expression, is this really a "tough act to follow?" Perhaps it is, but I believe that Phase II only sets up the basis for even greater accomplishments in the years ahead. Although Phase II should continue well into the 1970s, advancements in the state of the art will presumably continue to occur, and thus thought should begin now as to how best to meet the next generation requirement that is sure to come. We at DCA will continue to keep abreast of technological improvements with a view to ever expanding and improving the Phase II capability. In this regard, we will be anxious to improve "on board" signal processing. Eventually we would like to have a direct satellite-to-satellite communications relay capability. We would like also to exploit higher frequencies, if at all practicable. Possibly, we might like to reorient the entire pattern of satellite communications from the frequency division to the time division mode of transmission. There is much that can still be done, presenting a challenge for both DOD communications managers and industry.

The ability of DOD to meet the overall program objectives and fully optimize the satellite communications technology in the Defense Satellite Communications System appears to be limited only by the imagination and resources applied by both industry and DOD. Collectively, we have the technological "know how" to plan, engineer, and produce a Phase II system of satellites and earth terminals at greater cost effectiveness, but with more performance, increased reliability, and improved maintainability.

Lieutenant General Richard P. Klocko, USAF, is Director, Defense Communication Agency, and Manager, National Communications System. In prior assignments he was Commander, Air Force Communications Service, and Air Force Security Service. He is a 1937 graduate of the U.S. Military Academy, West Point, N.Y.

Guidance—A Maturing Technology

Address by Gen. James Ferguson, USAF, Commander, Air Force Systems Command, at the Fourth Guidance Test Symposium, Holloman AFB, N. M., Nov. 6, 1968.

Gen. James Ferguson, USAF

Since the technical subjects of this conclave should be adequately covered at the panel sessions, I thought that my remarks today might concern broader issues with relation to inertial guidance technology and its systems.

"Without a guidance system, a missile is nothing but a vast pyrotechnic display."

In this remark lies the very "heart of the matter" concerning not only missiles, but every target-aimed vehicle in our inventory, present or future.

Whether the target is a point on earth or a landing area on the moon, the "miracle steering" of an inertial guidance system or inertial navigation system must be the vehicle's way of getting there.

It is the concern of the Air Force, and the Systems Command in particular, in seeing that both offensive and defensive weapons hit their marks, that their missions end at the proper destination, at the proper time, with the specified accuracy. It is also our concern that these weapons contain the best available guidance systems, that they be cost effective, and that they have a reliability far in excess of anything we have ever experienced.

A tremendous number of the communications that come across my desk today concern guidance. The operational commands seek the ultimate passive system. The systems analysts in DOD place a very high significance on cost effectiveness. The theatre commands want the most reliable systems.

It is the business of the Central Inertial Guidance Test Facility at Holloman AFB and the Systems Command headquarters at Andrews AFB to satisfy everyone in these aspects. I just mentioned that one of the areas of our concern is the ultimate inertial guidance package. We are far beyond any nation in the world—free or enslaved—in this technology, perhaps by years. However, we developed the first such system in 1950—the XN–1. It guided a C–47 to a preselected target, effected a 180 degree turn and brought the plane back to base. That was 18 years ago. At the *same time, our fastest experimental* aircraft were only capable of speeds up to about 800 miles per hour but today our X–15 has flown over 4,500 miles per hour. That is almost six times as fast. Are today's guidance systems six time better than the XN–1 I realize that they are better—tremendously better—but we have not yet arrived at the pure passive inertial system. This would be six times better.

I hear a lot of talk about our approach to a technical plateau, that because we moved so rapidly in this field and are so far ahead, we can afford to turn on the auto-pilot and relax a bit. This is a dangerous state of complacency. We cannot maintain the *status quo*, and I include slight advances as being *status quo.*

We need quick-reaction, inertial navigation techniques that will reduce our current reaction time required for a one mile-per-hour accuracy. We need a low-cost air-to-surface missile midcourse guidance system that will sell for $3,000 rather than $15,000. We need coherent, side-looking radars to meet the offensive and recce missions. I could cite a dozen other requirements ranging from pure inertial through combined, inertial-electromagnetic to pure electromagnetic. We need more than we can get—faster than we can get them—now.

I just returned from the Farnborough show in England. From what I saw and from what I have learned, the Soviets are working night and day to upset the *status quo*. There are a number of possible advances or even breakthroughs that would give them decided advantages over us. We would be most unwise to let them take a lead in technology through our own lack of decisive effort. We must, at all times, maintain a technical momentum in order for our nation to maintain adequate strength across the entire spectrum of deterrence.

To maintain this momentum does not mean that "price is no object". To the contrary. We cannot spend all our money on guidance hardware. The Systems Command, as well as the systems analysts in DOD, is more than ever thinking along cost-effective lines. This is for good reason. I might cite one example. A $2 million missile contains $800,000 worth of guidance and control hardware. Frankly, this is too expensive. The Air Force must insure that the best combination of economy and performance be the prime requisites in the procurement of inertial equipment—not just performance.

Without question, *the application of two considerations is necessary: the all too familiar state of the art* with regard to performance, and the *less familiar state of the economy with respect to cost.* For too many years, these have been the only considerations in determining technical acceptability and the low bidder. All *too often*, this has resulted in the purchase of equipment which appeared

very attractive from the standpoint of initial cost but ended up in excessive funding for operational support. Particularly I have in mind one type of fighter whose guidance systems costs the Air Force $20 million annually because of one specific part that constantly requires maintenance.

We have a study under way to determine the feasibility of placing inertial system procurement under an approach similar to systems planning and management.

If this technique is adopted, the state-of-the-art considerations will not only include the present requirements such as accuracies, reaction times, power, weight, size, etc., but also reliability and maintainability. The state-of-the-economy considerations, in addition to initial costs, will include complete user costs with respect to user rate, pipeline time, repairs, maintenance, requirements for additional systems and spares, and inventory control.

All these factors will have to be considered even as early as during the advance development stage rather than after. If we have to go this route to bring cost within reason, we shall.

As you are aware, I included reliability in the state-of-the-art considerations. Every morning at my staff meetings I am provided with a rundown of every aircraft accident in the Air Force. All too often these accidents occur because of the failure of one 69-cent part—a pin, a washer, a diode or potting compound. All too often the failure occurred somewhere in the guidance system. Some of our planes cost more than $6 million. Regardless of that famous World War II phrase, they are *not* expendable, and neither are the pilots. Especially not for 69 cents.

The keys to improved reliability are the retention and utilization of experience and quality workmanship. We have all traveled a long, hard road in the electronic systems reliability effort. There has been massive documentation of our reliability efforts, but we have still not gone far enough in providing the factual documentation that insures us the use of experience gained and gives us the raw material for effective quality assurance. The failure of those 69-cent parts attests to this. We have not gone far enough with directive policies, the sinews of sound, effective reliability control.

I say "we" because industry and the Air Force are a team in the inertial guidance field, and we both share big stakes in the success of our joint efforts.

Basically, however, reliability is the responsibility of the contractor, the man who makes the hardware. Reliability should be an inherent built-in characteristic of the finished product. It is not an extra premium, but a basic requirement of contract performance. It is becoming an increasingly important factor in contractor evaluation and source selection, now that the industrial base, particularly for electronics and guidance procurements, has broadened, and the records of proved past performance are available to us.

I have no doubt but that the future problems associated with the reliability of guidance will get more difficult. Systems will be more complex, have more subsystems and, in turn, more components and more parts. There is an added importance to reliability. Each system has more capability than its predecessor, and thus has farther reaching effects, both in success and failure. Reliability must be assured when the system is delivered, not later. If we get a system today, then spend two years to modify it or alter it to make it operationally acceptable, we end up with a 1968 system in 1970. This is not acceptable. Our competition with the iron and bamboo curtain countries is too grim for this.

We must insist that industry continue to face the necessity for making reliable, operationally-acceptable sys-Force. He stated our policies and re-tems on time.

I would like to conclude with some remarks by Dr. Joseph Charyk, former Under Secretary of the Air quirements very succinctly. He said:

> **With the pace of modern technology, and with the criticality of superior military capability to national security, to be second may well be suicidal. The key then is a combination of simple, but difficult, things—a mature judgment as to the areas of critical importance, a willingness to take calculated development risks, a solid determination and will to terminate promptly or reorient programs where new factors have changed the tenets on which the program was launched, an assertive and prompt response to new and challenging possibilities, and a willingness by industry and Government to experiment with new contracting and management methods with premiums for performance and penalties for malperformance.**

We must be realistic about the problems confronting us. We must be equally realistic about the actions we can take to solve these problems. Over the past 18 years we have met and mastered a host of staggering problems in the field of inertial guidance. In the same spirit, I am confident we can meet the challenges facing us now.

Weapon Systems Trends in the Army

Address by Lt. Gen. F. J. Chesarek, USA, Asst. Vice Chief of Staff, U. S. Army, at the Luncheon for Sustaining Members of the Association of the U. S. Army, Washington, D. C., Oct. 30, 1968.

I would like to share with you a parable written by Benjamin Franklin in which he described how to make a Striking Sundial so that all the neighborhood for 10 miles around could know the time when the sun shines without having to look at the dial. In short, Mr. Franklin proposed:

> **In an open field with no impediment to sunshine, mark out hour lines, as for a sundial. On the line for one o'clock, place one cannon; on the two o'clock line, two cannons; and so on. The furrows must all be charged with powder, but ball is unnecessary. Around the sundial, place lenses to light powder trains; number one, for example, at one o'clock would fire one gun. At two o'clock, a focus shall fall on line two, kindle another train, and discharge two guns successively; and so on.**

Mr. Franklin then notes that the hief expense will be the powder; the '8 cannons, once bought, will with :are last 100 years, and there will be \ great saving of powder on cloudy lays. He then concludes:

> **Kind reader, Methinks I hear thee say that it is indeed a good Thing to know how the Time passes, but this Kind of Dial would be very Expensive; and the Cost greater than the Advantage. Thou art wise, my Friend, to be so considerate beforehand; some Fools would not have found out so much 'til they had built the Dial and try'd it.**

Franklin's admonition to weigh cost against advantage now falls under the terminology of cost effectiveness, a new tool of management science.

Today, the protagonists of such a sundial would also consider tradeoffs. After satisfying themselves of the advantages to be gained versus the costs involved, they might propose surrendering a quantity of watches, clocks and other model sundials equal in value, after discounting, to the investment and operating cost of the new sundial over a period of years.

Needless to say, this concern for the cost of introducing a new system into inventory has a profound significance to both the Military Services and to industry. Its implications are great. They extend into force structure, doctrine, and manning levels, as well as into equipment inventories.

In my article written for the Association of the United States Army *Green Book*, I used the case study of the AH-56A—the Cheyenne helicopter gunship—to illustrate the concept of equal cost tradeoff. I would like to use it again now, very briefly.

To field this new helicopter at the earliest practicable date and to take advantage of certain contract option prices, the Army in the spring of 1967 requested authority from the Secretary of Defense to initiate its procurement. The Army recognized that, in the long run, the new capability provided by the AH-56A would permit some tradeoff of other systems already in the inventory. The Secretary of Defense agreed that the system should be introduced but concluded that the Army should identify and trade off other systems so that, over a 10-year period, the cost of the Cheyenne system would be offset by the cost of the tradeoff.

The Defense Department employs the technique of equal cost tradeoff to encourage the uniformed Services to exercise their best judgments and analytic capabilities in recommending the best mix of forces and weapon systems.

In considering the future application of tradeoffs, we must examine the course of the Army's doctrinal evolution to get a feel for the size and shape of the Army of the 1970s and 1980s. You will note that this evolution is not based on any really new concepts; rather, it is a matter of emphasis on proven principles, some of which have roots going back to Biblical times.

I have singled out eight trends which, in my view, dominate our professional landscape:

- **Night operations.**

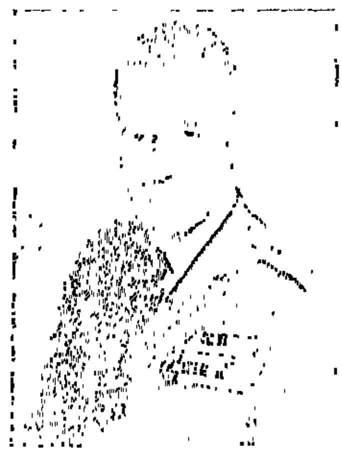
Night operations will become much more extensive and meaningful as night vision devices continue to improve. This opens new spectrums of tactics, type and density of equipment, intelligence, target acquision, and command and control. Equipment-wise, we must consider three aspects: needs of the individual soldier, combat surveillance, and target acquisition. Work in all areas is being pushed hard, with emphasis on the immediate needs of our forces in Vietnam. For a classic example of night operations, we can go back to Alexander the Great's victory in 326 B.C. at the Hydaspes River in India. What we are talking about today, however, is new in the sense of common versus unique doctrine. This field of endeavor holds as much promise for the Army as TV did for the communications media 20 years ago.

- **Tactical air mobility.**

The advantages of tactical air mobility have been proved, and the practice is certain to be expanded with unlimited scope for innovation. This includes not only the capacity to move people and materiel of all types, but also surveillance aircraft functioning under any kind of operating condition and gunships with a 24-hour, all-weather capability. We must also increase aircraft survivability and reduce vulnerability, especially to fire. While only about 24 percent of our aircraft accidents result in fire, about 75 percent of all fatalities resulting from aircraft accidents are caused by fire.

- **Equipment weight.**

Weight is an impediment to battle.



Lt. Gen. F. J. Chesarek, USA

This applies across the board. Although this fact was not just revealed yesterday, it is receiving priority attention. Weight has a direct bearing on the tactical air mobility point I just made, and it goes considerably further. We have moved aggressively in the area of individual equipment. We are now looking at the total spectrum. Tactical mobility is the sum of many factors. We relearn this lesson every time we engage in combat—and unlearn it in peacetime when we become enamoured with the niceties of luxury and gadgetry. In this regard, industry tends to egg us on, producing visions of compound use machines capable of performing miracles. And we are guilty of falling prey to wishful thinking — of disregarding lessons we learned the hard way. We need less of this sort of thing.

- **Target acquisition.**

Delivery of heavy firepower at point targets in very short time spans is highly productive. Ways are being sought to improve the means and techniques of application. This includes the need for improved target acquisition systems of all types—radar, electronic devices, and direction finding systems. A key consideration here is the improvement of accuracy. With better accuracy, ammunition consumption is reduced and a big cumulative pay-off is produced.

- **Logistics support.**

Entirely new logistics support systems are evolving based on the computer, airlift and containerization. I have long felt that we in the Army have not capitalized on industry's

proven capability to assist us in this complex business.

- Command and control.

Advances in communications and data manipulation capability are revolutionizing command and control. From the division level up, computers will be used to store enemy and friendly unit data, visually display the tactical and logistical situation, and assist in decision making by evaluating proposed courses of action and presenting a list of most to least favorable. The computer's capacity for storage and rapid computation can also be applied to a multitude of other tasks. For example, commanders can use the computer's help in evaluating combat readiness, supply capabilities, and intelligence.

- Equipment reliability.

Reliability of equipment is becoming an absolute necessity as maintenance becomes more complex and costly. Designing with maintainability specifically in mind is increasingly important, as is more sophisticated and reliable diagnostic equipment. We must be prepared to pay for this product in initial investment costs, confident that in short order we will be able to amortize the investment by savings in logistics support and manpower.

- Manpower costs.

There is a growing realization of the total cost of manpower. This realization leads to pressures to get more utility from each soldier and to reduce the numbers needed.

These trends—I have enumerated eight, but there are others of significance—will be the Army's bench marks in calculating its future needs and in applying tradeoffs where required.

I would like to expand a bit on total cost of manpower, since it is the dominant cost factor in weapon system cost-effectiveness analyses.

The average annual base pay of a soldier is approximately $3,000. To this must be added the cost of his individual equipment, his retirement and insurance benefits, his upkeep, food, medical support, housing, etc. Thus, the total annual cost averages out at $6,830. As most weapon systems have at least a 10-year life, we equate their manpower element for a similar time span. Our single soldier cost now becomes $68,300 in a weapon system life cycle. With a thousand soldiers—roughly, only one battalion—that means $68,300,000. We can buy a lot of hardware for that kind of money, if it can be manned and serviced with substantially fewer people than the hardware being traded off.

There is still another aspect of post-Vietnam weapon systems introduction that is of special concern to industry. I call it cost constrained programming.

It is quite clear to me that the end of the Vietnam war will be accompanied by two conflicting resource positions. On the one hand, the Army can expect to be pressed hard to reduce its spending. At the same time, some of the new systems, such as Sentinel, Cheyenne, and MBT–70 (the new main battle tank) will be reaching the production stage with their high price tags.

Cost Constraints

That portion of the gross national product which is devoted to defense appropriations may be considered an expression of the American public's concern with the perceived threat to our national security. The percentage varies from year to year, but a general trend can be observed over time (barring a general war situation) which establishes a limit to the amount the nation is willing to spend on defense. In the non-war years, within the Army's portion of the defense appropriation, we have been spending about 20 percent of our dollars for military hardware and ammunition. If we start with the limits we can derive from an economic analysis of our budget projections, we may find that priorities are easier to establish for the total mix of our hardware.

As an example of how this type of analysis can constrain a single developmental system, it may be useful to look briefly at the case of the mechanized infantry combat vehicle, a member of the combat tracked vehicle family. The armored personnel carrier currently in the Army inventory was developed in the late 1950s. It was introduced in quantity in the early 1960s. As a rule of thumb, it is reasonable to expect a major item to have a useful life of about 12 years. On that basis, we should now be along the road toward development of a personnel carrier to be introduced in the mid-1970s. The Army has, in fact, established the military requirements and obtained data from industry which has shown us some attractive designs. These promise to give us more room for our infantrymen and their weapons in a much higher performance vehicle that should be able to live quite a bit longer on the battlefield and, at the same time permit more tactical innovations than our current carrier. However, the new carriers cost quite a bit more money. They cost so much more, in fact, that we sent a requirements group back to the drawing board to give us a greater visibility on each improvement feature. We want a vehicle with performance characteristics meeting our most desired requirements and at a total systems cost which can be defended. We also want a vehicle that can be procured in priority competition with other systems.

This example illustrates only one of the techniques which we must refine. We must also examine procurement schedules for high cost programs and examine operating cost savings versus procurement expenditure tradeoffs.

Turning now to different approaches, we must improve our ability to tap the resourcefulness of industry along the path of product improvement, which offers substantial pay-offs for relatively small investment. Another path—a path that is somewhat overgrown because it has borne insufficient traffic—is the utilization of existing inventions and systems in unconventional ways. Modern industry, as the greatest family of innovators in our history, could be very useful in assuming initiatives in these areas.

As we look ahead a few years, there are positive trends of tactics and associated hardware, support, command and control, and management systems which, when taken together, will determine the size and shape of the Army of the 1970s. The ever rising cost of national defense compels us to consider manpower conservation as a principal element in the cost equation. Postwar domestic and international demands can be expected to put further pressures on the defense budget.

Industry must keep abreast of all of the elements of change, and the Army will do well to develop cooperative measures to capitalize on industry's innovative capability to help it come out on top.

How Big Is a Small Business?

Clyde Bothmer

[Editor's Note: This is the sixth and last article in a series contributed to the *Defense Industry Bulletin* by Clyde Bothmer, Deputy Associate Administrator, Small Business Administration.]

The broad scope of industries which are eligible for programs of the Small Business Administration (SBA) is not widely known. The public tends to associate SBA with small retail establishments or manufacturing operations with basically simple requirements. Because of these misconceptions, members of the public are sometimes surprised at how sophisticated some small businesses are. In point of fact, there are a number of highly capable small firms making significant contributions to the defense industry and to the other sectors of the economy.

These firms are not small in technical capability or knowledge nor, perhaps, by the standards which the average citizen would apply, even by number of employees. The law, however, recognizes that in business the question of size is a relative one. Size standards are established in the environment of the business world, the market place; and similarly, those standards are a part of the frame of reference for every business, regardless of size.

The Small Business Act, as amended, provides that a small business concern is "one which is independently owned and operated and which is not dominant in its field of operation." In addition to this general statutory definition, the Administrator of the Small Business Administration is authorized to make a detailed definition of small business. Where the number of employees is used as one of the criteria in making a detailed definition, the number varies from industry to industry to the extent necessary to reflect differing characteristics of such industries and to take a proper account of other relevant factors.

The definition of small business also varies depending on the assistance program under consideration. There are different standards for the business loan programs, government procurement assistance, and the small business investment company program. The size standards for government procurement assistance tend to be higher than for the business loan program, because government requirements and specifications are frequently more sophisticated or exacting than for comparable commercial items. It is, therefore, necessary to adjust the standards in recognition of the situation.

Size Standards

Staff work on size standards for all the various programs is performed in the Size Standards Staff under the Associate Administrator for Procurement and Management Assistance. The specific, applicable definitions are published in the Small Business Size Standards Regulation, available from Regional Offices of SBA (for listing of Regional Offices, see article "Subcontracting and Small Business," *Defense Industry Bulletin*, July 1968, page 4.)

Any consideration of size standards begins with the aforementioned established regulation which divides business into general, industry classifications and, specifically, addresses divisions of those classifications. For purposes of government procurement, for example, the classifications are: construction; manufacturing; nonmanufacturing (those proposing to sell items which they do not themselves produce); research, development and testing; transportation; and refined petroleum products. Within each of these areas specific standards are established. Under manufacturing, for instance, a lengthy schedule sets forth a list of industries, according to the Standard Industrial Classification Manual published by the Bureau of the Budget, with the maximum number which may be employed if a firm is to be considered a small business. Other provisions handle certain exceptions. The standard for manufacture of passenger cars, for example, has the effect of making all automobile manufacturers small businesses, except the traditional "big three," *if* they are bidding on a contract for passenger cars within Census Classification Code 37171. In this industry the three largest producers have 97 percent of the market for passenger cars produced in the United States.

Interpretation of the statutory definition of small business depends upon the meanings established by SBA for the phrase, "not dominant in its field of operations," and the term "affiliate." The significance of the first, a direct quote from the Act, is obvious and the official meaning quickly stated: a firm is "not dominant in its field of operations" when it does not exercise a controlling or major influence, on a national basis in a kind of business activity in which a number of business concerns are primarily engaged. Consideration i given to all appropriate factors, such as volume of business, number o employees, competitive status of position, nature of business, etc.

The meaning of "affiliate" is im portant for two reasons: first, an more significant, the question of in dependent ownership and operatio

is determined here; second, all affiliates of a firm are considered together when the size criteria, such as employee numbers, are applied. Firms are affiliates of each other when, either directly or indirectly, one concern controls or has the power to control the other; or a third party or parties controls or has the power to control both. Consideration is given to factors such as common ownership, common management, and contractual relationships. For example, the president of one small firm, who owned a large block of stock in a second small business, might create an "affiliation" through his office and ownership. If, however, the two firms together did not exceed the size standard, there would be no problem in either business qualifying as a small business.

The Process of Modifying Size Standards

Within this framework the size standards are subject to modification as appropriate. Current data on the economy and on the various industries is continually evaluated for significance to the standards, and revisions are developed as necessary. Other changes begin with a request to SBA from another governmental agency or an industry/trade association that a particular standard be reviewed. As a general rule the request is directed toward an increase in the maximum size of a small business under the regulation. Although there is nothing wrong with such a suggestion, *per se*, the staff reviewing the request must balance the specific proposal against the undeniable fact that the position of small business would be nominally excellent, and actually abominable, if the standards were simply revised to qualify everyone. A statistical victory would scarcely be in the spirit of the Congressional intent, so the changes must be weighed carefully.

To review a prospective change, the Size Standards Staff obtains current and historical data on the size and composition of the industry concerned; government procurements and set-asides within this classification are evaluated; and past bidder's information is considered. If after this examination it appears that there is a reasonable case to be made for the proposed change, the Administrator authorizes announcement of the suggested modification in the Federal Register. Interested parties usually are given 15 to 30 days to make comments on the proposal. Occasionally, when data available to SBA are not considered adequate or appropriate, or if the subject matter requires a more intensive review, a hearing will be held at which oral testimony on the subject is received in addition to documentary presentations.

After comments are returned, the Size Standards Staff reviews the case once again, this time weighing information provided by members of the industry and other concerned parties. After this evaluation the case is presented to the Administrator with the staff recommendation for action. The final decision—whether to refuse or accept the original proposal, or perhaps to make a change not originally proposed—is made by the Administrator. The decision is then announced in the Federal Register and incorporated into the Size Standard Regulations.

Although SBA establishes the standards and makes the final determination of whether a firm qualifies as a small business, it is the contracting officer who is responsible for one of the most critical decisions on a given procurement, as far as small firms are concerned. The contracting officer, subject to the right of appeal, makes the determination of which industry classification and, therefore, which size standard applies to firms interested in the procurement. It is not unusual for an item to be classified under two areas. The classification is significant principally in set-asides. A set-aside, as discussed in a previous article of this series (see article, "Prime Contracting Program of Small Business Administration," *Defense Industry Bulletin*, August 1968, page 18), is the reservation of a portion of a procurement, or an entire procurement, for competition by small businesses.

Once the classification is made and a set-aside determined, the regular procurement procedure follows. Bidders certify that they are small businesses when bids are submitted. Should there be some doubt as to a bidder's qualification, any other bidder may register a protest with the contracting officer, who will forward the protest to the SBA Regional Office serving the area where the principal office of the protested firm is located. Similarly, the contracting officer may himself file such a protest. The Regional Office will then acknowledge the protest to both contracting officer and protesting firm, and will request the protested firm to provide information regarding its business and size as well as a response to the specific allegations of the protest. The answer must be returned within three days of receipt of the request or the protested concern will be ruled "other than a small business." After the response is provided, SBA determines the small business status of the protested concern and notifies the concerned parties of the result within 10 working days.

Who May Appeal Small Business Status?

The process described herein is one of three which may lead to review by the Size Appeals Board in SBA's Central Office. An appeal may be taken by any concern or other interested party which has:

- Protested the small business status of another concern as described herein, and whose protest has been denied by a Regional Director.
- Been adversely affected by a decision of a field office.
- Been adversely affected by a decision of a contracting officer regarding product classification.

Appeals are addressed to the Chairman, Size Appeals Board, Small Business Administration, Washington, D.C. 20416. No particular form of protest is established, but the appellant is expected to include any information pertinent to the circumstances of the appealed situation and a concise statement of his argument, along with documentary evidence supporting his contentions. The board informs interested parties, providing copies of the notice of appeal. Those parties then have five working days to submit a statement of their position on the appeal. The board, composed of the Deputy Administrator, the Associate Administrators for Procurement and Management Assistance and for Financial Assistance, and the Assistant Administrator for Planning, Research and Analysis, gives

(Continued inside back cover)

Top 100 Defense Contractors Announced

Top 100 Companies and Their Subsidiary Corporations Listed According to Net Value of Military Prime Contract Awards Fiscal Year 1968 (July 1, 1967—June 30, 1968)

The 100 companies, which together with their subsidiaries, were awarded the largest dollar volume of military prime contracts of $10,000 or more in FY 1968, accounted for $26.2 billion, or 1.9 percent more than in FY 1967. The total awarded to all U.S. companies was $38.8 billion, which was 1 percent less than in FY 1967.

Although the total volume of awards was almost the same in both fiscal years, there were sizeable increases in the procurement of ammunition, missiles and space equipment, petroleum, and transportation services. Awards decreased in clothing and textiles, construction, and miscellaneous commercial type items. In general, the industries affected by the increased defense procurement are more highly concentrated than those affected by decreased procurement. It is principally for this reason that the top 100 companies received 1.9 percent more of the FY 1968 than of the FY 1967 total, or 67.4 percent compared with 65.5 percent.

Listing of the top 100 companies and their subsidiaries, in order of rank, is given below. The report is compiled by the Directorate for Statistical Services in the Office of the Assistant Secretary of Defense (Comptroller), Washington, D. C. 20301.

Rank	COMPANY	THOUSANDS OF DOLLARS
	U. S. TOTAL [a]	$38,826,626
	Total, 100 Companies & Their Subsidiaries [b]	26,171,192
1.	General Dynamics Corp	2,231,488
	Dynatronics Inc	27
	Stromberg Carlson Corp	7,782
	United Electric Coal Co	42
	TOTAL	2,239,330
2.	Lockheed Aircraft Corp	1,858,363
	Lockheed Shipbuilding Construction	11,834
	TOTAL	1,870,197
3.	General Electric Co	1,485,096
	General Electric Supply Co	3,611
	TOTAL	1,488,707
4.	United Aircraft Corp	1,320,091
5.	McDonnell Douglas Corp	1,087,660
	Conductron Corp	5,372
	Hycon Mfg Co	7,805
	TOTAL	1,100,837
6.	American Telephone & Telegraph Co	161,405
	Chesapeake & Potomac Telephone Co	13,018
	Illinois Bell Tel Co	38
	Mountain States Tel & Tel Co	1,872
	New England Tel & Tel Co	549
	New Jersey Bell Telephone Co	529
	New York Telephone Co	152
	Northwestern Bell Telephone Co	235
	Ohio Bell Telephone Co	601
	Pacific Northwest Bell Telephone	160
	Pacific Telephone & Telegraph Co	225
	Southern Bell Telephone & Telegraph	2,178
	Southwestern Bell Telephone	1,197
	Teletype Corp	22,591
	Western Electric Co Inc	571,177
	TOTAL	775,027
7.	Boeing Co	762,141
8.	Ling Temco Vought Inc	50,011
	Altec Service Co	58
	Braniff Airways Inc	46,304
	Continental Electronics Mfg Co	4,238
	Jefferson Wire & Cable Corp	151
	Jones & Laughlin Steel Corp	605
	Kentron Hawai Ltd	8,549
	L T V Electrosystems	123,592
	L T V *Aerospace* Corp	487,782
	L T V Ling Altec Inc	886
	Memcor Inc	25,883
	National Car Rental System	11
	Okonite Co The	1,656
	Wilson & Co Inc	8,290
	Wilson Pharmaceutical & Chem Corp	16
	Wilson Sporting Goods Co	150
	TOTAL	758,261
9.	North American Rockwell Corp	668,482
	Remmert-Werner, Inc	159
	TOTAL	668,641
10.	General Motors Corp	629,515
	Frigidaire Sales Corp	95
	TOTAL	629,610
11.	Grumman Aircraft Engineering Corp	629,197
12.	Avco Corp	583,648
13.	Textron Inc	18,488
	Accessory Products Co	138
	Bell Aerospace Corp	478,691
	Bell Aerosystems Co	100
	Bostitch Inc	14
	Camcar Screw & Mfg Co	80
	Fafnir Bearing Co	1,501
	Fanner Mfg Co	66
	Talon, Inc	332
	Textron Electronics Inc	093
	Townsend Co	297
	Waterbury Farrel	102
	TOTAL	500,747
14.	Litton Industries, Inc	28,752
	Aero Service Corp	822
	Allis (Louis) Co	1,318
	Alvey Ferguson Co	130
	Clifton Precision Products Co	27
	Eureka X-ray Tube Corp	38
	Ingalls Shipbuilding Corp	277,289
	Kimball Systems, Inc	22
	Litton Precision Prods Inc	6,829
	Litton Systems Inc	150,386
	Monroe International Inc	43
	Profexray Inc	27
	Royal Typewriter Co, Inc	13
	TOTAL	466,601
15.	Raytheon Co	431,241
	Amana Refrigeration Inc	18
	Machlett Laboratories Inc	19,350
	Micro State Electronics Corp	125
	Raytheon Education Co	020
	Seismograph Service Corp	94
	TOTAL	451,754
16.	Sperry Rand Corp	447,197
17.	Martin Marietta Corp	357,642
	Amphenol-Borg Electronics, GMBH	280
	Bunker Ramo Corp	35,526
	TOTAL	393,454
18.	Kaiser Industries Corp	97
	Kaiser Aerospace & Electronics *Co*	5,615
	Kaiser Jeep Corp	295,803
	Kaiser Steel Corp	52,886
	National Steel & Shipbuilding *Co*	31,933
	TOTAL	386,334
19.	Ford Motor Co	76,771
	General Micro-Electronics, Inc	170
	Philco Ford Corp	304,403
	TOTAL	381,344
20.	Honeywell Inc	351,025
	Computer Control Co Inc	57
	TOTAL	351,082
21.	Olin Mathieson Chemical Corp	329,415
22.	Northrop Corp	182,150
	Hallicrafters Co	33,467
	Northrop Carolina Inc	26,188
	Page Communications Engineers Inc	
	Secoa, Inc	
	Warnecke Electror	
	TOTAL	

23. Ryan Aeronautical Co	133,751
Continental Aviation & Engr Corp	30,142
Continental Motors Corp	111,891
Wisconsin Motor Corp	8,374
TOTAL	293,158
24. Hughes Aircraft Co	285,858
MEVA Corp	251
TOTAL	286,109
25. Standard Oil of New Jersey	148
American Cryogenics Inc	251
Enjay Chemical Co	93
Esso AG	1,310
Esso International Corp	144,905
Esso Petrol Co Ltd	92
Esso Research & Engineering Co	1,164
Esso Standard Eastern Inc	340
Esso Standard Italiana	2,035
Esso Standard Oil Co SA	2,584
Esso Standard SAF	119
Esso Standard Thailand Ltd	124
Humble Oil & Refining Co	121,212
TOTAL	274,377
26 Radio Corp of America	254,961
RCA Defense Electronics Corp	39
RCA Institutes Inc	12
TOTAL	255,012
27. Westinghouse Electric Corp	247,664
Thermo King Corp	1,466
Thermo King Sales & Service	66
Westinghouse Electric Supply Co	1,319
Westinghouse Learning Corp	524
TOTAL	251,039
28. General Tire & Rubber Co	11,636
Aerojet Delft Corp	979
Aerojet General Corp	210,232
Batesville Mfg Co	24,182
Fleetwood Corp	10
Frontier Airlines Inc	21
General Tire International Co	996
TOTAL	248,056
29. International Telephone & Tel Corp	135,713
Amplex Corp	67
Barton Instrument Corp	37
Consolidated Electric Lamp Co	11
Continental Baking Co	2,194
Federal Electric Corp	65,499
ITT Electro Physics Laboratories	2,715
ITT Gilfillan Inc	34,809
ITT Technical Services Inc	521
TOTAL	241,566
30. International Business Machine Co	223,023
Science Research Associates Inc	199
Service Bureau Corp	439
TOTAL	223,661
31. Bendix Corp	214,398
Bendix Field Engineering Corp	7,426
Bendix Westinghouse Auto-Motive	175
Dage Electric Co Inc	13
Fram Corp	1,017
Mosaic Fabrications Inc	195
P & D Mfg Co Inc	331
TOTAL	223,555
32. Pan American World Airways Inc	205,652
33. F M C Corp	175,860
Gunderson Bros Engineering Corp	9,406
TOTAL	185,266
34. Newport News Shipbld & Dry Dck Co	181,248
Nuclear Service & Constr Co, Inc	61
TOTAL	181,309
35 Raymond Morrison Knudsen (JV)	176,000
36. Signal Companies Inc (The)	
Dunham Bush Inc	465
Garrett Corp	114,620
Mack Trucks, Inc	48,407
Signal Oil & Gas Co	5,792
Southland Oil Corp	2,287
TOTAL	171,571
37. Hercules Inc	170,242
Haveg Industries Inc	1,119
TOTAL	171,361
38. Dupont E I De Nemours & Co	30,662
Remington Arms Co	139,907
TOTAL	170,569
39. Texas Instruments Inc	169,271
40. Day & Zimmerman Inc	166,240
41. General Telephone & Electn Corp	93
Automatic Electric Co	9,682
Automatic Electric Sales Corp	1,829
General Telephone & Electronic Lab	273
General Telephone Co of Southeast	151
Hawaiian Telephone Co	4,626
Lenkurt Electric Co Inc	8,650
Sylvania Electric Products Inc	133,706
TOTAL	159,010
42. Uniroyal Inc	154,163
Uniroyal International Corp	136
TOTAL	154,299
43. Chrysler Corp	146,586
Factory Motor Parts Co	14
TOTAL	146,600
44. Standard Oil Co of Calif	71,462
Caltex Asia Ltd c	1,853
Caltex Oil Products Co c	61,766
Caltex Oil Thailand Ltd c	1,995
Caltex Overseas Ltd c	379
Caltex Philippines Inc c	436
Chevron Asphalt Co	50
Chevron Chemical Co	797
Chevron Oil Co	2,153
Chevron Oil Co of Venezuela	1,610
Chevron Shipping Co	1,297
Standard Oil Co Kentucky	2,297
Standard Oil Co Texas	122
TOTAL	146,217
45. Norris Industries	139,064
Fyr Fyter Co	202
TOTAL	139,266
46. Texaco Inc	45,404
Caltex Asia Ltd c	1,853
Caltex Oil Products Co c	61,766
Caltex Oil Thailand Ltd c	1,995
Caltex Overseas Ltd c	379
Caltex Philippines Inc c	436
Jefferson Chemical Co Inc	105
Texaco Antilles, Ltd	88
Texaco Export Inc	22,561
Texaco Puerto Rico Inc	2,451
White Fuel Co Inc	984
TOTAL	138,022
47. Collins Radio Co	134,754
48. Goodyear Tire & Rubber Co	55,358
Goodyear Aerospace Corp	76,201
Motor Wheel Corp	2,046
TOTAL	133,605
49. Asiatic Petroleum Corp	132,796
50. Sanders Associates Inc	130,830
Mithras Inc	481
TOTAL	131,311
51. Mobil Oil Corp	128,06
52. T R W Inc	120,36
Globe Industries Inc	34
International Controls Corp	67
Ramsey Corp	14
United-Carr, Inc	70
TOTAL	127,467
53 Mason & Hanger Silas Mason Co	127,004
54 Massachusetts Institute of Technology (N)	124,143
55 Magnavox Co	123,100
56. Fairchild Hiller Corp	121,165
Burns Aero Seat Co Inc	94
TOTAL	121,259
57. Pacific Architects & Engineers Inc	120,895
58. Thiokol Chemical Corp	119,363
59. Eastman Kodak Co	117,566
Eastman Chemical Products Corp	51
Eastman Kodak Stores Inc	706
TOTAL	118,323
60 United States Steel Corp	108,322
Reactive Metals Inc	161
US Steel International, Inc	7,679
TOTAL	116,162
61. American Machine & Foundry Co	108,871
Cundo Engineering Corp	1,052
TOTAL	109,923
62. Chamberlain Corp	104,441
63 General Precision Equipment Corp	
American Meter Controls Inc	20
Controls Co of America	377
General Precision Decca Systems	90
General Precision Systems Inc	86,361
Graflex Inc	1,671
Industrial Timer Corp	15
National Theatre Supply	10
Strong Electric Corp	9,605
Tele-Signal Corp	6,686
Vapor Corp	2,104
TOTAL	103,044
64. Lear Siegler Inc	74,000
American Avitron	43
L S I Service Corp	27,526
Transport Dynamics Inc	685
Verd A Ray Corp	18
TOTAL	102,272
65. Harvey Aluminum Inc	25,048
Harvey Aluminum Sales	71,045
TOTAL	96,093
66. National Presto Industries Inc	96,886
67. Teledyne Inc	77,173
ADCOM Inc	300
Amelco, Inc	4,146
Continental Device Corp	27
Crystalonics Inc	13
Electro Development Co	50
Geotechnical Corp	25
Getz William Corp	128
Gill Electric Mfg Corp	617
Hydra Power Corp	1,017
Irby Steel Co	59
Isotopes Inc	802
Landis Machine Co	22
Micronetics Inc	346
Microwave Electronics Corp	30
Milliken D B Co Inc	1,024
National Geophysical Co Inc	92
Ordnance Specialties Inc	24
Packard Bell Electronics Corp	6,504
Penn Union Electric Corp	11

Teledyne Inc (cont'd)	
Pines Engineering Co, Inc	158
Rodney Metals, Inc	11
Wah Chang Corp	26
TOTAL	92,514
68. City Investing Co	
American Electric Co	35,960
Hayes Holding Co	49,002
Rheem Mfg Co	1,857
Wilson Shipyard, Inc	164
TOTAL	86,989
69. Colt Industries, Inc	2,258
Chandler Evans, Inc	10,087
Colts Inc	68,989
Elox Corp	194
Fairbanks Morse, Inc	4,582
Pratt & Whitney Inc	436
TOTAL	86,546
70. Western Union Telegraph Co	79,299
71. American Mfg Co of Texas	76,552
72. Curtiss Wright Corp	74,799
Comet Tool & Die Co	350
Zarkin Machine Co	275
TOTAL	75,424
73. White Motor Co	15,976
Hercules Engines Inc	58,610
Minneapolis Moline Inc	394
TOTAL	74,980
74. Aerospace Corp (N)	73,541
75. Cessna Aircraft Co	71,834
Aircraft Radio Corp	1,076
TOTAL	72,910
76. Emerson Electric Co	63,776
Pace Inc	68
Rantec Corp	31
Ridge Tool Co	26
Supreme Products Corp	8,807
Wiegand (Edwin L) Co	134
TOTAL	72,842
77. Seatrain Lines Inc	42,039
Commodity Chartering Corp	1,667
Hudson Waterways Corp	22,547
Transeastern Shipping Corp	4,348
TOTAL	70,601
Gulf Oil Corp	66,934
Goodrich Gulf Chemicals Inc	81
Gulf Oil Trading Co	259
Pittsburg Midway Coal Mining Co	104
TOTAL	67,378
79. Condec Corp	65,162
Consolidated Controls Corp	1,587
N J E Corp	155
TOTAL	66,904
80. Motorola Inc	65,715
Motorola Overseas Corp	218
TOTAL	65,933
81. Continental Air Lines Inc	64,523
82. Federal Cartridge Corp	64,519
83. Hughes Tool Co	62,533
84. Vitro Corp of America	59,674
Vitro Minerals Corp	1,471
TOTAL	61,145
85. Johns Hopkins University (N)	57,674
86. Control Data Corp	50,225
Associated Aero Science Labs Inc	1,891
C E I R Inc	852
Control Corp	142
Electronic Accounting Card Corp	728
Pacific Technical Analysts, Inc	1,705
T R G Inc	1,264
TOTAL	56,802
87. Lykes Corp	55,247
Gulf & South American Steamship Co	683
TOTAL	55,930
88 McLean Industries, Inc	
Equipment Inc	5,902
Gulf Puerto Rico Lines, Inc	259
Sea-Land Service, Inc	49,751
TOTAL	55,912
89. Aerodex Inc	55,345
90 Susquehanna Corp	2,415
Atlantic Research Corp	51,452
Xebec Corp	886
TOTAL	54,753
91. Sverdrup & Parcel & Assocs Inc	1,396
Aro Inc	53,165
TOTAL	54,561
92 States Marine Lines Inc	54,015
93 Hazeltine Corporation	53,781
94 Atlas Chemical Industries Inc	53,574
95. Vinnell Corp	51,609
96. Harris-Intertype Corp	913
Gates Radio Co	796
PRD Electronics, Inc	20,613
Radiation, Inc	29,156
TOTAL	51,478
97. World Airways Inc	51,358
98. International Harvester Co	51,271
99. Automatic Sprinkler Corp America	50,395
Badger Fire Extinguisher Co	38
TOTAL	50,433
100. Smith Investment Co	
Smith A O Corp	40,323
Smith A O of Texas	9,998
TOTAL	50,321

FOOTNOTES:

[a] Net value of new procurement actions minus cancellations, terminations, and other credit transactions. The data include debit and credit procurement actions of $10,000 or more, under military supply, service and construction contracts for work in the United States, plus awards to listed companies and other U.S. companies for work overseas.

Procurement actions include definitive contracts, the obligated portions of letter contracts, purchase orders, job orders, task orders, delivery orders, and any other orders against existing contracts. The data do not include that part of indefinite quantity contracts that have not been translated into specific orders on business firms, nor do they include purchase commitments or pending cancellations that have not yet become mutually binding agreements between the Government and the company.

[b] The assignment of subsidiaries to parent companies is based on stock ownership of 50 percent or more by the parent company, as indicated by data published in standard industrial reference sources. The company totals do not include contracts made by other U.S. Government agencies and financed with Defense Department funds, or contracts awarded in foreign nations through their respective governments. The company names and corporate structures are those in effect as of June 30, 1968, and for purposes of this report company names have been retained unless specific knowledge was available that a company had been merged into the parent or absorbed as a division with loss of company identity. Only those subsidiaries are shown for which procurement actions have been reported.

[c] Stock ownership is equally divided between Standard Oil Co. of California and Texaco, Inc; half of the total of military awards is shown under each of the parent companies.

(N)—Non-profit.

(JV)—Joint venture of Raymond International, Inc.; Morrison-Knudsen Co.; Brown & Root, Inc.; and J. A. Jones Construction Co.

Army Extends Vertical Management to More Equipment Categories

Modern concepts for vertical management of weapon systems are being extended to additional categories of equipment at the Army Missile Command, Redstone Arsenal, Ala., with establishment of two product management offices and two new commodity offices.

Items designated for product management are Target Missiles and the Land Combat Support System (LCSS). Product management offices are also being planned for the Air Defense Control and Coordination System and Multiple Artillery Rocket System.

New commodity offices established at the Missile Command are for Aircraft Weapons and for Land Combat Weapons.

Colonel Robert W. Van Wert has been named acting Product Manager for Target Missiles pending arrival of the designated product manager, Lieutenant Colonel William L. Rehm.

New Product Manager for LCSS is Lieutenant Colonel Frank A. Matthews. He is being transferred to the new post from duty as head of the System Support Division of the Pershing Project Manager's Office.

William Rotenberry has been selected as Acting Chief of the Aircraft Weapons Commodity Office, and Herman Martin will serve as Acting Chief of the Land Combat Weapons Commodity Office.

The Aircraft Weapons Commodity Office will manage the application of TOW missiles on the new Cheyenne helicopter, and airborne rocket launchers.

The Land Combat Weapons Commodity Office covers management of the Honest John and Littlejohn rockets, ENTAC and the LAW training device.

MEETINGS AND SYMPOSIA

JANUARY

Aerospace Sciences Meeting, Jan. 20–22, at Statler Hilton Hotel, New York, N.Y. Sponsor: American Institute of Aeronautics and Astronautics. Contact: American Institute of Aeronautics and Astronautics, 1290 Sixth Ave., New York, N.Y. 10019.

Fundamental Interactions at High Energy Conference, Jan. 22–24, at University of Miami, Coral Gables, Fla. Sponsor: Air Force Office of Scientific Research. Contact: Capt. D. R. Lehman, Air Force Office of Scientific Research (SRPN), 1400 Wilson Blvd., Arlington, Va. 22209, Phone: (202) 694-5581.

System Sciences Conference, Jan. 22–24, at University of Hawaii, Honolulu, Hawaii. Sponsors: Air Force Office of Scientific Research, Army Research Office, Office of Naval Research, National Science Foundation, and the University of Hawaii. Contact: Capt. A.D. Dayton, Air Force Office of Scientific Research (SRMA), 1400 Wilson Blvd., Arlington, Va. 22209, Phone: (202) 694-5261.

International Symposium on Information Theory, Jan. 28-31, at Ellenville, N.Y. Co-sponsors: Air Force Office of Scientific Research and Institute of Electrical and Electronic Engineers. Contact: Maj. P.J. Daily, Air Force Office of Scientific Research, 1400 Wilson Blvd., Arlington, Va. 22209, Phone: (202) 694-5261.

FEBRUARY

Second Air Force Metalworking Technology Conference, Feb. 24–27, at Hotel Sahara, Las Vegas, Nev. Sponsor: Metallurgical Processing Branch of Air Force Materials Laboratory, Wright-Patterson AFB, Ohio. Contact: Air Force Metalworking Technology Conference, Universal Technology Corp., 1388 Research Park Drive, Dayton, Ohio 45432.

MARCH

Airbreathing Propulsion for Advanced Missile and Aircraft Symposium, March 4–6, at Naval Training Center, San Diego, Calif. Security classification: SECRET. Sponsors: Air Force Aero Propulsion Laboratory, Air Force Rocket Propulsion Laboratory, and Naval Weapons Center. Contact: Leonard Dickey, Air Force Aero Propulsion Laboratory (APR), Wright-Patterson AFB, Ohio 45433, Phone (513) 255-5221.

APRIL

International Symposium on Global Problems in Analysis, April 2–4, at Princeton University, Princeton, N.J. Sponsor: Air Force Office of Scientific Research. Contact: Dr. R.G. Pohrer, Air Force Office of Scientific Research (SRMM), 1400 Wilson Blvd, Arlington, Va. 22209, Phone: (202) 694-5264.

Army Numerical Analysis Conference, April 24–25, at Walter Reed Army Institute of Research, Washington, D.C. Sponsor: U.S. Army Research Office—Durham. Contact: Dr. Francis G. Dressel, Mathematics Div., U.S. Army Research Office—Durham, Box CM, Duke Station, Durham, N.C. 27706, Phone: (919) 286-2285.

MAY

Frequency Control Annual Symposium, May 6-8, at Atlantic City, N.J. Sponsor: Solid State and Frequency Control Div., Electronics Components Laboratory, U.S. Army Electronics Command. Contact: M.F. Timm, Electronic Components Laboratory, U.S. Army Electronics Comand, Fort Monmouth, N.J. 07703, Phone: (201) 535-2250.

Annual Conference on Power Sources, May 20–22, at Shelburne Hotel, Atlantic City, N.J. Sponsors: U.S. Army Electronics Command and Interagency Advanced Power Group. Contact: Galen R. Frysinger (AMSEL-KL-P), U.S. Army Electronics Command, Fort Monmouth, N.J. 07703.

Anopheline Biology and Malaria Eradication Conference, May 21–23, 23, at Washington, D.C. Sponsors: Armed Forces Pest Control Board and the Forest Glen Section of the Walter Reed Army Medical Center. Contact: Lt. Col. John E. Scanlon, Chief, Department of Entomology, Division of Communicable Diseases and Immunization, Walter Reed Army Institute of Research, Washington, D.C. 20315, Phone: (202) 576-3719.

JUNE

Shock Tube International Symposium, June 23–25, at University of Toronto, Canada. Sponsor: Air Force Office of Scientific Research. Contact: M. Rogers, Air Force Office of Scientific Research (SREM), 1400 Wilson Blvd., Arlington, Va. 22209, Phone: (202) 694-5568.

New AFSC Unit To Support Bare Base Concept

Air Force Systems Command (AFSC) has activiated a new management organization called the Air Mobility Division to support the continuing and expanding bare base concept.

The new Air Mobility Division assumes the functions of the former Bare Base Office and operates under jurisdiction of Aeronautical Systems Division's Deputy for Limited War at Wright-Patterson AFB, Ohio.

The bare base concept envisions the development of highly mobile facilities, which can be flown to an advanced site and erected immediately to provide the essential elements for a suitable operational base.

The Air Mobility Division was established to develop equipment which will improve the capability of Air Force operational and support forces to rapidly deploy to, and operate from, bare base sites anywhere in the world. Colonel Gerald K. Hendricks heads the new division.

2,000 New Family Housing Units Set for FY 1969

The Defense Department has announced a $40 million housing construction program for FY 1969 which calls for the production of 2,000 military family housing units to be located in 12 states.

The Army will get 500 units, 750 will be constructed at Navy installations, and 750 at Air Force sites.

Following is a breakdown of building sites and number of units to be constructed:

Marine Corps Air Station, Yuma, Ariz. 100

George AFB, Calif. 200

Fort Gordon, Ga. 200

Naval Complex, Oahu, Hawaii 150

Pacific Missile Range Facilities, Kauai, Hawaii 56

Mountain Home AFB, Idaho 250

Fort Levenworth, Kan. 100

Naval Air Test Center, Patuxent River, Md. 100

Naval Auxiliary Air Station, Fallon, Nev. 44

Holloman AFB, N.M. 300

Naval Complex, Newport, R.I. 100

Fort Hood, Tex. 200

Naval Auxiliary Air Station, Chase Field, Tex. 100

Naval Air Station, Whidbey Island, Oak Harbor, Wash. 100

Airborne Warning Office Reorganized

An organizational change involving the 411L Airborne Warning and Control (AWACS) System Program Office (SPO) has been announced by the Air Force Systems Command's Electronic Systems Div., at L. G. Honscom Field, Mass.

The System Program Director, Colonel Kendall Russell, will now report directly to Electronic Systems Division commander. Before the organizational change, the SPO was a subdivision of the Deputy for Surveillance and Control Systems.

The AWAC System will provide the Air Force with a quick reaction airborne command and control system for global deployment as well as a survivable warning and control capability for the air defense of the Continental United States.

Military Services Join in Test Effort To Meet Tactical Communications Needs

The U.S. Army, Navy and Air Force have begun the second phase of a joint test effort to determine the feasibility of using ultra-high frequency (UHF) communication satellites to meet the expanding communication needs of U.S. tactical armed forces.

Initial tests have been accomplished using a limited number of terminals located throughout the United States with the recently launched Lincoln Experimental Satellite (LES-6), now in a synchronous parking orbit about 22,000 statute miles above the equator. The first phase of this joint Service experiment was accomplished with LES-5, the predecessor of LES-6.

The Air Force System Command's Electronic Systems Division (ESD), L. G. Hanscom Field, Mass., is responsible for the coordination and conduct of the joint Service LES-6 test effort.

In this joint endeavor, ESD is also procuring additional UHF terminals suitable for deployment in aircraft ships, submarines, helicopters and mobile ground vehicles of the Military Services for the Tactical Satellite Communications Operational Feasibility Test Program to be tested with LES-6 later in the test program.

Colonel Harley L. Grimm, director of the Tactical Satellite Communications Program at ESD stated that, "Various objectives will be reached by this testing including the actual performance of the equipment, the feasibility of reliable satellite communications between geographically separate forces in operational environments, the existence of electromagnetic compatibility, and a study of the basic characteristics of the system.

He further stated, "The testing along with the resultant data collected and evaluated will provide a base for the development of the Tactical Satellite Communications System. In addition, it will provide a trained cadre of Air Force, Army, Navy and Marine Corps personnel familiar with the complex ultra-high frequency terminal equipment, the traffic handling procedures, and operating characteristics representative of the final system."

The organizations participating in the joint Service test of LES-6 are Lincoln Laboratory, Lexington, Mass.; Air Force Avionics Laboratory, Wright-Patterson AFB, Ohio; Rome Air Development Center, Griffiss AFB, N.Y.; Naval Electronics Laboratory, San Diego, Calif.; Naval Air Development Center, Johnsville, Pa.; Navy Underwater Sound Laboratory, New London, Conn.; Naval Electronics Systems, Test and Evaluation Facility, Webster Field, Md.; the Army Satellite Communications Agency, Fort Monmouth, N.J.; and the U.S. Coast Guard. As the program progresses, additional organizations including operational units will participate in testing with LES-6.

The agencies responsible for conducting this joint test program within each Service are: the Army Satellite Communications Agency, Fort Monmouth, N.J.; the Naval Electronics Systems Command, Washington, D.C.; and the Air Force Electronic Systems Division, L. G. Hanscom Field, Mass.

Major Henry Zinke of the ESD Tactical and Survivable Communications Systems Program Office is the joint Service project officer coordinating the test.

AFLC Guidance Unit Redesignated

The Air Force Logistics Command has established the Aerospace Guidance and Metrology Center at Newark Air Force Station, Ohio, replacing the 2802nd Inertial Guidance and Calibration Group. The center is the single point in the Air Force for repair of inertial guidance systems for aircraft and missiles. It also maintains the Air Force measurement standards and directs the world-wide calibration program.

The name change is part of a general reorganization, grouping major activities into four directorates under the headings of maintenance, metrology, service engineering, and supply and support.

The center is commanded by Colonel Morris C. Burkhart.

ASPR Committee Case Listing

The following is a listing (revised as of Nov. 12, 1968) of the cases currently under consideration by the Armed Services Procurement Regulation (ASPR) Committee, of the Office of the Assistant Secretary of Defense (Installations and Logistics).

On items marked by asterisks, the text has been omitted to shorten the listing. The asterisks denote actions taken as shown below:

**—Case closed, no ASPR revision resulting.*

***—Case closed, approved for printing in a subsequent ASPR revision.*

****—Case closed, approved for printing subject to further government coordination.*

The listing includes subjects of interest to contractors but excludes cases of a minor or editorial nature, those considered "sensitive," and those involving a deviation from the regulation which are processed by the ASPR Committee.

The ASPR Committee meets with representatives of major industry associations periodically to explain the purpose and status of each of the cases under consideration, and to answer questions from industry representatives concerning the cases. All proposed ASPR changes of major policy are forwarded to industry associations in draft form for the review and comments of the association memberships. Industry comments are evaluated by the Defense Department before a final decision on the proposal is made by the ASPR Committee.

Rental Charges for Use of Government Property. To consider whether the adoption of a policy of charging rent for use of government property, across the board, would be more practical and less burdensome in assuring against competitive advantage and would result in a decline in the number of requests for use of government property generally. No definitive action has been taken on the numerous proposed solutions to this matter. This problem is still under consideration.

** Industry Cost Sharing.

Cost Principle—Depreciation. To review the depreciation guidelines and rules issued by new Revenue Procedures 65-13, and to prepare appropriate changes to ASPR 15-205.9 which may be necessary as a result of Revenue Procedures 65-13 issued by the Internal Revenue Service. After considering industry comments, revised coverage has been approved for printing in the 15-205.9 paragraph. However, printing of the .9 paragraph is being withheld until action to revise 15-205.32 covering "Gains and Losses on Disposition of Depreciable Property and Other Capital Assets" is complete. As a result of industry comments received on the .32 paragraph, the principle was changed to simplify both the language and the procedures for determining the gain or loss. Because of this change, the revised cost principle was again forwarded to industry for comment on May 31, 1968. These comments are under consideration.

Equal Employment Opportunity. To develop implementation of the Department of Labor revised rules with respect to the subject matter. ASPR implementation has been developed and forwarded to the Department of Labor for approval.

Review of the Implementation of Public Law 87-653. To undertake a review of the ASPR implementation of Public Law 87-653 on the basis of the experience thus far obtained, to determine the need for further guidance or clarification of such coverage. This review has been divided into five broad areas as follows:

(a) The submission of data. When is data submitted? Submission vs. disclosure or availability. Identification of data. Contracting Officer (and other) documentation.

(b) Definitions of "current" and "complete." From the standpoint of reasonableness and practicability. How should significance be considered?

(c) Examination of Records. Audit before negotiation. Audit after contract award. Audit of subcontractor data.

(d) Subcontract Problems. Subcontracts under firm fixed-price primes. Second and third tier subcontracts.

(e) Significance. From the standpoint of price negotiation vs. application of defective pricing clause. Price changes after price agreement but before contract award.

Proposed coverage on (a), (b), (c) and (e) was previously circulated to industry for comment, and the results of this effort were issued in Defense Procurement Circular No. 57, dated Nov. 30, 1967.

Proposed coverage on the subcontract aspect of this matter was forwarded to industry for comment on March 4, 1968, with a request that comments be presented by May 4, 1968. Pursuant to industry's request, the date for submission of comments was extended to July 7. Industry comments are being considered.

Cost Information Reports (CIR). Proposed ASPR coverage for Cost Information Reports (CIR) has been developed and was approved for print by the ASPR Committee. However, printing has been withheld based upon information that the basic DOD instruction is in the process of being changed and that the changes contemplated will require redrafting the ASPR coverage. Revision of the instruction is still in process.

Contract Modifications. To develop a new ASPR Section consolidating service material dealing with all types of contract modifications. Consideration of this subject is continuing.

Handbook for Procurement Quality Assurance. To prepare an ASPR Supplement which will provide standardized procedures, where possible, for use of government inspection and quality assurance personnel. The proposed coverage, providing internal guidance to inspection and quality assurance personnel, has been approved for printing, subject to ratification by higher authority.

** **Contractor Utilization of Industrial Production Equipment.**

** **Transportation.**

Communications Services. Development of uniform ASPR coverage which would permit deletion of existing departmental coverage with respect to procurement of communication services from both regulated and unregulated suppliers. Industry comments have been received, considered, and revised coverage developed. Final action on this coverage has been delayed awaiting review by high authority.

Advance Understandings of Allowability, ASPR 15-107. To revise the existing ASPR paragraph to explicitly provide that such agreements must be in writing to be binding on the Government. Proposed ASPR coverage concerning Advance Understandings on Particular Cost Items was forwarded to industry for comment on May 29, 1968. The comments received from industry and other government agencies have been reviewed. Final action on this case will be undertaken in the near future.

Compensation Review Procedures. To prepare procedures to be followed by government personnel to assure that compensation paid to contractor employees performing on government contracts is reasonable. The subcommittee report is being evaluated.

* **Training and Educational Costs, ASPR 15-205.44.**

Help Wanted Advertising, ASPR 15-205-33. To consider revising the cost principle to define the type of recruiting advertising that is allowable. Prior to undertaking a revision of the subject cost principle, the committee determined to seek industry assistance in an effort to obtain data which could be used in assessing the benefits of (i) institutional type advertising containing help wanted advertisements, in contrast with (ii) help wanted advertising in the classified section of the daily newspapers. A response from CODSIA providing data in this area was received on April 26. The proposed revision of the principle was forwarded to industry for comment on July 22. Industry and government agency comments have been received and are being considered.

Technical Data Warranty. To consider the advisability of incorporating in ASPR a warranty clause for technical data. Proposed ASPR coverage with respect to the subject matter was forwarded to industry for comment on May 17, 1968. Industry comments have been received and are under consideration.

** **Price Representation Clause.**

Predetermination of Rights in Data. To reconsider the predetermination policy and its application, and determine the practical utility of the procedures and whether the procedures should be revised. Proposed ASPR coverage on the subject matter was forwarded to industry for comment on March 14, 1968 with a request that comments be presented by May 14. On May 8, 1968, pursuant to industry's request, the date for submission of comments was extended to June 14. Industry comments have been received and considered. It is contemplated the final action will be taken on this matter in the near future.

Reporting of Labor Disputes. To consider revising the coverage contained in ASPR 12-101.3, "Reporting of Labor Disputes," and the ASPR clause in 7-104.4, "Notice to the Government of Labor Disputes," to clarify and simplify the reporting of labor disputes under the subject coverage. This case has been enlarged to revise and update all of Section XII, with the exception of Part 8 covering "Equal Employment Opportunity."

Modification of Weighted Guidelines to Give Greater Recognition to Invested Capital. To develop a revision to the present weighted guidelines coverage to give more recognition to contractor investment.

Purchase vs. Lease; Allowability of Costs Under ASPR 15-205.34 and 15-205.48 for ADPE, Other Equipment and Buildings. To clarify 15-205.34(b) in light of the General Accounting Office report alleging improper application; revision of 15-205.48 to provide that a "price" established pursuant to 15-205.22(e) may be used for the purpose of determining ownership costs of ADPE rented from an affiliate; modify 15-205.9 to insert a new paragraph (g) to clearly point out that depreciation cost basis of any equipment, including ADPE, may be at a "price" established pursuant to 15-205.22(e); modify 15-205.34 and .48 to specifically provide that "interest" and other nonallowable costs are to be excluded in comparing or limiting rental costs to those of ownership; and to clearly provide that "interest" is not an allowable cost. Proposed ASPR coverage with respect to the subject matter was forwarded to industry for comment on May 27, 1968. Industry comments have been received and are under consideration.

Revisions to ASPR 15-205, Cost Principles on Bid and Proposal and Independent Research and Development. The proposed revisions to the existing ASPR cost principles on Independent Research and Development and Bid and Proposals were developed as a staff action outside of the ASPR Committee and referred to the Committee for editing and the obtaining of industry comments. This material was forwarded to industry on Jan. 29, 1968. On March 25, 1968, the reporting date for submission of comments by Industry and government agencies was extended to June 30, 1968. Industry comments have been received and are under study.

** **Contractor Performance Evaluation (Development) Expansion.**

Revision to ASPR 15-205.41—Taxes. To develop a revision to existing ASPR cost principles to assure that Opinion No. 11 of the Accounting Principles Board of the American Institute of Certified Public Accountants that "income tax expense should include tax effects of revenue and expense transactions included in the determination of pretax accounting income," shall not apply to allowable costs. A proposed revision of the 15-205.41 paragraph to accomplish the foregoing was forwarded to industry for comment on June 10, 1968. Industry comments have been received and are currently being considered.

* **Preference for U.S. Flag Aircraft.**

* **CPFF Contracts and Progress Payments for Fixed-Price Contracts, Expediting Payment.**

** **Relocation Costs, ASPR 15-205.25.**

Evaluation of Options. To consider revising the ASPR policy on options, subject to approval by General Accounting Office, to provide criteria for the evaluation of options in conjunction with the initial solicitation, in certain limited situations (*e.g.* where it is anticipated the Government may exercise the option at time of award; there is a known requirement exceeding the quantity to be awarded, but due to the unavailability

of funds the option cannot be exercised at time of award; etc.).

Limited Rights Legend. To consider developing a revision of the Limited Rights Legend and coverage in ASPR to clarify with particularity the use of limited rights data by the Government.

Clauses for Service Contracts. To develop a new Part for ASPR Section VII to cover service contracts generally, incorporating by reference, to the extent feasible, the fixed-price and cost-reimbursement clauses contained in Parts 1 and 2 of Section VII.

Organization Costs, ASPR 15-205.23. To consider the development of a revision to the subject ASPR cost principles to identify mergers and acquisitions as a part of organization and reorganization costs, and to clarify that both the cost of employees and outside services involved in such actions are unallowable.

First Article Approval. To consider revising the First Article Approval policy set forth in Section I, Part 19, in light of the difficulties which have been experienced both by the Government and by industry under the existing ASPR coverage.

Revision of the CWAS Coverage. To consider recommendations submitted by the IAC Working Group to lower the threshold and also extend the CWAS coverage to certain areas of administrative controls now excluded from the CWAS coverage.

Proposed ASPR 9-203(f) Clause, Rights in Technical Data—For RDT&E and Acquistion Contracts for Major Systems and Subsystems. To consider modifying the ASPR policy concerning rights in technical data insofar as RDT&E and acquisition contracts for major systems and subsystems are concerned, by prescribing a special clause for inclusion in prime major systems and prime subsystems RDT&E contracts which would require the contractor to permit subcontractors to sell subcontractor fabricated parts or services directly to the Government without the payment of license fees or other inhibition, notwithstanding that such subcontractor effort may require the use of limited rights data furnished by the prime contractor.

Mandatory Application of ASPR Cost Principles in Fixed-Price Contracts. To develop a revision of ASPR Section XV, Part 6, to make use of the cost principles set forth in Parts 2, 3 and 4 mandatory in fixed-price contracts whenever costs are relevant in the pricing of fixed-price contracts.

Multiple Incentive Contracts

(*Continued from page 6*)

Soon after POESMIC officially opened, each Service issued a policy letter on use of POESMIC resources. All Army, and Navy and Air Force multiple-incentive contracts over $5 million must be structured with the aid of the POESMIC services. To date, POESMIC has had 52 actions totaling about $10 billion.

For readers interested in more information about these techniques, POESMIC has two manuals, one detailed and the other condensed, covering the evaluation and structuring programs. They are:

- USAF Academy Consulting Team Report on the Evaluation and Structuring Techniques of Multiple Incentive Contracts.
- Training Manual for Orientation Course on Evaluating and Structuring Multiple-Incentive Contracts.

Three 16mm films are also available:

- Visibility in Structuring Multiple Incentive Contracts.
- Tradeoff Analysis in the Evaluation of Multiple Incentive Contracts.
- Value Statement Technique for Structuring Multiple Incentive Contracts.

These manuals and films may be obtained from Space and Missile Systems Organization, Attention: SMKPD, Los Angeles Air Force Station, Los Angeles, Calif. 90045.

As the result of a study recently completed by the Assistant Chief of Staff for Studies and Analysis, Headquarters, U.S. Air Force, an additional manual and film will be available from POESMIC in the near future. Both will carry the title "Government Value Analysis in Multiple Incentive Contracts."

Almost 60 years have passed since the first performance incentive contract was awarded. Hopefully, modern multiple incentive contracts will motivate modern contractors to exceed specifications and requirements as much as the Wright Brothers did.

New Test for Solid Propellant Rockets

A new technique used in testing solid propellant rocket motors in high altitude simulation test cells at the Air Force System Command's Arnold Engineering Development Center in Tennessee is providing information in motor performance which could not be acquired previously.

Until now, solid propellant motors were installed in the test cell on a semi-rigid stand which interfered with acquisition of precise ignition data.

The new technique permits the rocket motor to move forward virtually unrestricted, as it would in flight during the fraction of a second it takes for ignition of the propellant to become complete. Shock and acceleration forces are measured as the motor moves, and the data are free of inputs from support hardware interactions.

Engineers for ARO, Inc., contract operator of the Arnold Center, devised the technique for tests of the third-stage motor for a new model of the Athena booster system which is used in reentry experiments.

The third stage motor drives the payload back into the atmosphere and too much of a jolt during ignition could damage the delicate instruments in the payload. Primary objective of the test was, therefore, to determine if the instruments would be adequately insulated from the forces produced during ignition.

A secondary objective of the test was to determine tail-off characteristics at a simulated high-altitude. A sea level test by the manufacturer had indicated the motor continued to produce low levels of thrust for an abnormally long time after design burn-out. If this happened in flight, the additional thrust could drive the third stage into the payload and also damage the instruments after separation.

To accomplish the secondary objective, a special pressure probe system, also designed and developed at Arnold Center, was inserted in the motor case through the nozzle and six inches into the combustion chamber immediately after design burn-out time had been reached. Results showed no evidence of extended tail-off, indicating that the additional thrust recorded in the sea level test was produced by conditions not existent at high altitudes.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Maj. Gen. John S. Patton, Air Force Reserve, has been designated Chairman of the Reserve Forces Policy Board, which acts through the Asst. Secretary of Defense (Manpower & Reserve Affairs).

Col. Stewart C. Meyer, USA, brigadier general designate, has succeeded Brig. Gen. Allen M. Burdette, USA, as assistant to Dep. Dir. of Defense Research & Engineering (Tactical Warfare Programs).

DEPARTMENT OF THE ARMY

Lt. Gen. James B. Lampert has been designated by the Secretary of Defense to succeed Lt. Gen. Ferdinand T. Unger as Commanding General, U.S. Army Ryukyu Islands/IX Corps and High Commissioner of the Ryukyu Islands. Gen. Unger has been named to be Dir., Civil Disturbance Planning & Operations, Office of the Chief of Staff, U.S. Army. The Ryukyu Islands, situated south of Japan, include the strategic island of Okinawa, site of a huge military complex. The islands are administered by the United States in accordance with the peace treaty signed with Japan at the end of World War II.

Brig. Gen. Donald D. Blackburn has succeeded Brig. Gen. Thurston T. Paul as Dir., Plans and Programs, Office of the Chief of Research & Development.

Dr. Sidney Ross has been selected to serve as Technical Director of Research and Engineering at Frankford Arsenal, Philadelphia, Pa.

Resignation of Dr. Ralph G. H. Siu, Dep. Dir., Developments & Engineering, Army Materiel Command, has been announced.

Col. John W. Ervin is the new chief of staff for the Army Electronics Command, Fort Monmouth, N.J.

Col. Harold A. Kissinger, brigadier general designate, has been assigned as Dep. for Operations, Army Electronics Command, Fort Monmouth, N.J.

Col. George M. Snead Jr., brigadier general designate, has succeeded Brig. Gen. Charles D. Y. Ostrom Jr. as Director of Army Research. Gen. Ostrom has assumed duel responsibility as Commanding General, Army Ordnance Center, and Commandant, Army Ordnance School, Aberdeen Proving Ground, Md.

Col. Nelson W. Tobey has been assigned as head of the Missiles and Space Directorate, Office of the Chief of Research & Development.

Col. Robert G. Todd is the new Dep. Commander, Army Automatic Data Field Systems Command.

Col. James E. Wirrick is the new Commanding Officer, Army Behavioral Science Research Laboratory, Washington, D.C.

DEPARTMENT OF THE NAVY

RAdm. Paul A. Holmberg has been named Vice Commander, Naval Air Systems Command. RAdm. Raymond J. Schneider succeeds Adm. Holmberg as Asst. Commander Naval Air Systems Command for Research and Technology.

Capt. Winthrop P. Robinson has been assigned as the new Commanding Officer, Navy Space Systems Activity, at Los Angeles, Calif., Air Force Station.

Capt. Thomas T. Scambos has been ordered to duty as Manager of the Navy's F–111B Project Office at Naval Material Command.

DEPARTMENT OF THE AIR FORCE

The Air Force Systems Command has made the following assignments of key positions:

Brig. Gen. Alton D. Slay, Commander, Air Force Flight Test Center, Edwards AFB, Calif.; Col. David M. Critchlow, Test Engineer, Dep. Sys. Test, Air Force Flight Test Center, Edwards AFB, Calif.; Col. Gerald K. Hendricks, Director, Air Mobility Div., Deputy for Limited War, Aeronautical Systems Div., Wright-Patterson AFB, Ohio; Col. William P. Lemme, Dir. of Quality Assurance, Air Force Contract Management Div., Los Angeles, Calif.; Col. Edward H. Risher, Dir., Tech. Support, Armament Development & Test Center, Eglin AFB, Fla.; Col. Theodore H. Runyon, Chief of Staff, Aeronautical Systems Div. Wright-Patterson AFB, Ohio; Col. Robert A. Rushworth, Systems Program Dir., TAC Missile Programs, AGM–65A, Aeronautical Systems Div. Wright Patterson AFB, Ohio; Col. Kenneth J. Sarchet, Chief, Communications Div., Air Force Eastern Test Range, Patrick AFB, Fla.; Col. James W. Wood, Chief, Test & Development, FX System Program Office, Aeronautical Systems Div., Wright-Patterson AFB, Ohio, and Lt. Col. Reese S. Martin, Dir., Test & Deployment Div., F–111 Systems Program Office, Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

The Air Force Logistics Command has made the following assignments of personnel to key positions:

Col. Lester C. Mourer, Vice Commander, Advanced Logistics Systems Center, Wright-Patterson AFB, Ohio; Col. Thomas E. Peddy, Vice Commander, San Antonio Air Materiel Area, Kelly AFB, Tex.; Col. Rowland H. Worrel Jr., Dir., Supply & Transportation, Warner Robins Air Materiel Area, Robins AFB, Ga., and Col. Tom W. Robbins, Chief, Operations Support Div., Logsitics Systems Center, Wright-Patterson AFB, Ohio.

Brig. Gen. William G. King Jr., has been assigned as Asst. to Dir. of Special Projects, Office of the Secretary of the Air Force, with duty station at Los Angeles, Calif., Air Force Station.

Col. James J. Dimel has been assigned as Commanding Officer, Holloman AFB, N.M., site of the Air Force Missile Development Center.

Col. Roy D. Ragsdale has been reassigned to the Air Force Security Service as Dir., Electronic Systems, Air Force Special Communications Center, Kelly AFB, Tex.

Lt. Col. John J. Whiteside has been named Chief of the Air Force Office of Information in New York, N.Y.

DOD Plastics Analysis Center Open to Industry Query

Harry E. Pebly Jr.
Norman E. Beach

A recent study found that DOD is adding about $100 million annually in identifiable research in materials, of which $22 million goes for organic materials—primarily plastics and polymers. About $12 million is spent on composites research, of which a significant fraction is for reinforced plastics. (This does not include programs in structures.)

In addition to the Defense Department, the National Aeronautics and Space Administration (NASA) is funding about $5 million in plastics and the Departments of Agriculture, Commerce (Bureau of Standards) and Interior also have programs, although of smaller size. The sum of all these must put the Federal Government close to the $40 million mark in plastics and polymers.

versity and an M.S. degree from Stevens Institute. In 1966 he received a Certificate of Merit from the Reinforced Plastics Division of the Society of Plastics Industry.

It is known there is a much larger amount (estimated as much as four times greater) spent in unidentified research and development as part of end-item development. Unfortunately the knowledge gained from this effort is reported in only a small amount.

There has been no estimate made of the amount of purchased plastic goods by the Federal Government. Such goods may be easily identified, either as semi-finished products such as film and rigid laminates or end items such as rocket cases, or unidentified and unsung components such as electrical insulation. The total amount is obviously tremendous. However, procurement is done by so many different groups, in such a variety of agencies and locations, it is logistically impossible to get an accurate picture of the grand total. There are over 1,000 government specifications pertaining to plastics.

The Plastics Technical Evaluation Center (PLASTEC) located at Picatinny Arsenal, Dover, N.J., is one of 28 Defense Department information analysis centers established as authoritative sources in particular fields of defense mission.. These answer requests ation from anyone e defense effort. of them, including PLASTEC, publish reviews or state-of-the-art reports which are generally available for public sale, and they are usually well informed as to who is active in the field and what programs are underway. Through these centers the Government attempts to provide for the most effective use of the results of its research and development programs. (For a complete listing of DOD information analysis centers, see article on page 29 in this issue).

PLASTEC is the organization designated to collect, evaluate and disseminate technical information in the field of plastics, and has five materials specialists assigned to carry out the mission of the center. These specialists are able to supplement their knowledge with the talents available

Norman E. Beach has been Technical Publications Editor with PLASTEC for seven years. He is author of the book "Plastic Laminate Materials," and nearly a dozen technical reports on military uses of plastics. A chemist for more than 20 years, he has a B.A. degree from New York University and an M.A. degree from Harvard University.

in the large plastics laboratory organic to Picatinny Arsenal.

PLASTEC has concentrated in four areas: reinforced plastics in electrical and electronic applications; plastics in packaging and plastics in mechanical goods. The center aspires to coverage of the entire plastics and polymer field. The forte of the center is thus the analysis and evaluation of information, and it is this aspect which distinguishes an information analysis center from a library.

The Army is assigned the responsibility by the Defense Department for the operation of PLASTEC. The center, however, serves the Navy and the Air Force as well.

In addition, the services of the center are available to defense contractors and suppliers. On this point, the situation is analogous to that in which the tail wagged the dog. A large majority of the inquiries made of PLASTEC come from government contractors or suppliers, and they constitute a large portion of the mailing list for output documents. At the same time, the defense industries are a prime source for input documents, and are constantly called upon for pieces of information required in evaluations conducted by the center.

The specific areas of activity entered into by PLASTEC are determined by direct requests for studies to be made, or by the trends which are noted among the many inquiries handled by the center.

To illustrate the former, recently the Army Tank Automotive Command requested a state-of-the-art survey of plastics sandwich construction, to obtain information useful for materials selection, design and fabrication of vehicle bodies, fire walls, ballistics resistant panels, sound deadening panels, and flotation units. As for the latter, repeated and diverse requests for information on a particular subject (filament winding techniques, low temperature properties, cryogenic effects, etc.) are taken as indication that a general need exists for that information.

The natural repository for the technical information relating to plastics is the PLASTEC library. The library houses over 11,000 documents. These are, for the most part, reports of government agency projects or contracted studies. They are selected for call-in from various accession lists and from Current Awareness printouts from the Defense Documentation Center. Study of contract lists also provides valuable leads to potentially important documents.

The library holdings are incorporated in a continuing print-out system which provides for each item a formal citation and an abstract. The items are also indexed as to subject (under pertinent uniterms) and author. There is no loan-out system for the PLASTEC holdings; however, arrangement can be made for defense contractor personnel to visit the library for search and study.

Information is evaluated by a group of specialists, most of whom came to PLASTEC from industry. Since rapport with industry is vital to the operation of the center, they have established and they maintain their particular contacts within their particular fields. This personal source of information is supplemented by day-to-day contact with plastics engineers in the arsenal's Materials Laboratory. In frequent cases, a call to the right person will produce an immediate answer.

The areas of interest in which competence exists in PLASTEC are listed below:

- Ablative materials.
- Aircraft uses.
- Composites.
- Compatibility.
- Corrosion applications.
- Cryogenic properties.
- Degradation.
- Electrical properties.
- Encapsulation.
- Filament winding.
- Laminates.
- Low temperature properties.
- Mechanical uses.
- Medical uses.
- Microbiological effects.
- Missile components.
- Molding, forming and extrusion.
- Nondestructive testing.
- Packaging applications.
- Printed circuits.
- Space environment effects.
- Specifications.
- Thermal insulation.
- Weathering.

The output of PLASTEC is of two

Specific Techniques

PLASTEC	Short Title	Call Number
Report 1	Flake glass laminates	AD 244 104
Report 3	Electrical encapsulation	AD 247 865
Report 29	Electrical encapsulation	AD 648 420
Report 4	Package-cushioning	AD 273 400
*Report 10	Filament winding	AD 284 629
*Report 19	Filament winding	AD 457 598
Report 13	Fluidized-bed coating	AD 431 603
Note 18	Fluidized-bed coating	AD 666 224
Report 15	Plastics for tooling	AD 601 891
Report 16	Plastic gears	AD 605 396
*Report 22	Nondestructive testing	AD 472 712
Report 26	Reinforced thermoplastics	AD 637 721
Report 34	Sandwich construction	AD 673 713

* Not on public sale.

Figure 2.

Technical Conference Papers on Plastics

(Issued annually)

PLASTEC	Call Number	Year
Report 8	AD 264 775	1961
Report 11	AD 282 795	1962
Report 14	AD 428 560	1963
Report 17	AD 606 561	1964
Report 21	AD 620 142	1965
Report 27	AD 641 666	1966
Report 31	AD 660 954	1967
Report 35	(At press)	1968

Figure 1.

types: the inquiry response and the formal study report.

Many inquiries received by the center may be answered immediately or by call-back within a reasonable time. However, some may require a substantial investigation which usually results in the issuing of a response of some significance. Copies of these letter reports are kept on file, and are indexed for future use in answering related inquiries or for final expansion into formal reports.

Characteristic of these are selected reference lists or annotated bibliographies on particular subjects. These "unpublished reports" presently exceed 200 items; and, as with the library documents, are available to PLASTEC visitors for search and study.

The formal output of PLASTEC is discussed here rather fully, in order to bring to the attention of the reader the publications of the center which are available to him.

All reports may be obtained from the Defense Documentation Center (DDC), Cameron Station, Alexandria, Va. 22314, by those qualified for that service (see article "Programs and Services of the Defense Documentation Center," *Defense Industry Bulletin*, April 1968, page 1). They are distributed free in microfiche form, but there is now a charge of $3 for hard-cover copies. Users not qualified for DDC service can, in most cases, purchase PLASTEC reports from the Clearinghouse for Federal Scientific and Technical Information (CFSTI), 5285 Port Royal Road, Springfield, Va., 22151, at a cost of $3.

It was recognized long ago at PLASTEC that one area of information was not completely covered by other means. This is the wealth of technical knowledge which is presented at the various conferences held in this country and overseas, and published in sometimes quite limited editions of preprints or proceedings. As a guide to this information, the center annually prepares a subject index, bibliography and code description of those papers pertaining to plastics. Figure 1 cites the PLASTEC reports covering this area for the past eight years. These conference reports tell what has been presented on a particular subject and (by means of the code) what type of coverage is given in the particular papers. The source (conference and proceedings) is cited; also, the author and his affiliation.

Specific techniques reported on by the center are listed in Figure 2. These are largely state-of-the-art studies covering what has been done and what is being done on the stated subject, and including (as applicable) design considerations, material properties, and military uses. Second reports on the same subjects are bibliographical updatings or extensions on the techniques.

General Aids

PLASTEC	Short Title	Call Number
Report 5B	Directory in plastics	AD 642 574
Note 6A	Specifications list	AD 640 377
Note 9	Trade designations	AD 481 788
Note 14	Glossary of terms	AD 645 208
Note 17	Test methods	AD 662 049

Figure 4.

Design Aids

PLASTEC	Short Title	Call Number
Report 12	Space environment effects	AD 288 682
*Report 20	Cryogenic temperature properties	AD 469 126
Report 23	Electrical properties	AD 624 922
Report 24	Weathering	AD 630 987
Report 24	Weathering	AD 672 513
Report 25	Compability (liquid propellants)	AD 632 287
Report 33	Compatibility (solid propellants)	AD 672 061
Report 30	Low temperature effects	AD 661 683

*Not on public sale.

Figure 3.

Some of the studies executed by PLASTEC, while not tied-in with particular techniques, are of definite assistance to the design engineer in the selection of materials. These design aids are listed in Figure 3. The works cited are studies of material properties and behavior under selected environments, and as such they are valuable references in determining what has been experienced so far and what can be expected.

The output of PLASTEC has included reports of general value, as cited in Figure 4.

The directory (Report 5) is a guide to those people in various government segments (and in NASA and other government-contracted centers) who are knowledgeable in plastics, their research and development, and their uses in military applications. Provided is a subject index so that the reader can locate who to turn to for knowledge of a particular subject or item. The directory lists the name, segment, address and telephone number of that person. It also contains a list of personnel so that, given a name, the person can be reached. This directory, a most popular publication, is revised every three years. It is presently undergoing revision, with publication of Report 5C expected early in 1969.

As could be expected, the center received (and still receives) many inquiries as to "Is there a specification on ________?" or "What is covered by Type II of MIL-P-XXXX?" or "How do I get specification number ________?". Answering such questions prompted the compilation of a complete list of known government specifications and standards covering defense engineering plastic materials and applications (Note 6). In addition to identification media for the specifications, directions on procurement are included. This guide is re-

(*Continued on page 32*)

Scientific and Technical Information Analysis Centers

The Defense Department supports 28 Centers for analysis of scientific and technical information. Each center gathers information in its clearly defined, specialized area of interest, reviews, analyzes, evaluates, synthesizes, condenses, and summarizes the information, and provides it to individual users. These centers produce critical reviews, state-of-the-art monographs, data compilations, and substantive responses to queries.

DOD centers operate under the guidance of DOD Instruction 5100.45.

Each information analysis center is staffed by scientists, engineers and technicians who are skilled in the particular subject matter, and in information handling. These centers are distinguished from documentation centers and technical libraries, whose primary functions are handling documents, rather than the technical information contained in the documents.

A Directory of Federally Supported Information Analysis Centers is available from the Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, U.S. Dept. of Commerce, Springfield, Va. 22151. Price is $3. The directory lists 113 centers.

DOD-operated centers are listed below:

Air Force Machinability Data Center

Address:
Metcut Research Associates, Inc.
3980 Rosslyn Drive
Cincinnati, Ohio 45209

Director:
John Maranchik Jr.

Point of Contact:
John Maranchik Jr.
(Alternate) Robert E. Snider
Phone: (513) 271-9510

DOD Cognizance:
Air Force Materials Laboratory (MAAM)
Wright-Patterson AFB, Ohio 45433

Collects, evaluates, stores and disseminates material removal information including specific and detailed machining data for the benefit of industry and government. Strong emphasis is given to engineering evaluation for the purpose of developing optimized material removal parameters. Provides specific and detailed answers to technical inquiries in the field of material removal. Maintains a User File, consisting of 3,500 important users in the field of material removal; these receive information products including machining data pamphlets and tables on materials of current interest, state-of-the-art reports, technical announcements, and other appropriate items. Services are provided to the industry, DOD (including all of the Military Services and their contractors), and other government agencies, technical institutions, and non-military industries in a position to assist the defense effort.

Ballistic Missile Radiation Analysis Center

Address:
University of Michigan
Institute of Science & Technology
P. O. Box 618
Ann Arbor, Mich. 48107

Director:
Dr. F. S. Simmons
Phone: (313) 483-0500, Ext. 314 or 315

Point of Contact:
Dr. Frank Sevcik

DOD Cognizance:
Fred Koether
Advanced Research Projects Agency
Department of Defense
Washington, D. C. 20301
Phone: (202) 697-8904

Collects, processes and disseminates information on the theory and technology associated with ballistic missile phenomena which may be useful in the design of defense systems. Analyzes and evaluates theoretical and experimental results from the radiation measurements program, with primary emphasis on the optical radiation emanating during the launch, mid-course and reentry regimes of missile flight. Conducts semi-annual AMRAC symposium and publishes and distributes proceedings.

Battelle-DEFENDER Information Analysis Center

Address:
Battelle Memorial Institute
505 King Ave.
Columbus, Ohio 43201

Director:
Robert S Kohn
Phone: (614) 299-3151, Ext. 2041

DOD Cognizance:
Fred Koether
Advanced Research Projects Agency
Department of Defense
Washington, D. C. 20301
Phone: (202) 697-8904

Collects, processes and analyzes information in all disciplines covering research in defense against ballistic missiles. Provides a functional information system required to monitor existing and proposed work. Performs analyses and undertakes studies of critical system problems Prepares state-of-the-art reports, technical summaries, compendiums and annotated accessions lists. Provides services to the entire DOD ballistic missile defense community.

Chemical Propulsion Information Agency

Address:
Applied Physics Laboratory
The Johns Hopkins University
8621 Georgia Ave.
Silver Spring, Md. 20910

Director:
Leland B. Piper
Phone: (301) 589-7700, Ext. 561

DOD Cognizance:
Robert Heitkotter
Naval Air Systems Command (AIR-330 D)
Washington, D. C. 20360
Phone: (202) 696-7989

Acquires information and data from government-sponsored programs in chemical propulsion technology; organizes information and data in publications useful to members of the rocket community including government organizations, industrial concerns, universities, institutes and consultants working with chemical rocketry; disseminates information and data through meetings, briefings, consultation and publications; serves as a central source for chemical propulsion contract information so that duplication in government-funded research and development programs may be minimized; provides Interagency Chemical Rocket Propulsion Group with status reports in specific areas of research and development to aid managerial decisions; provides technical data in response to inquiries from scientists and engineers engaged in chemical propulsion research and development.

Coastal Engineering Information Analysis Center

Address:
Coastal Engineering Research Center
5201 Little Falls Road, N. W.
Washington, D. C. 20016

Director:
Thorndike Saville Jr.
Phone: (202) HO 2-8000, Ext. 708

DOD Cognizance:
Office, Chief of Engineers
Washington, D. C. 20315

Collects, analyzes and disseminates information on coastal engineering research and technology. Services include the publication of annotated bibliographies, state-of-the-art reports, and the provision of library and consultation services.

Concrete Technology Information Analysis Center

Address:
U. S. Army Engineer Waterways
Experiment Station
P. O. Box 631
Vicksburg, Miss. 39180

Director:
Bryant Mather
Phone: (601) 922–1671, Ext. 33
DOD Cognizance:
Office, Chief of Engineers (ENGSA)
Washington, D. C. 20315

Acquires, analyzes, evaluates and condenses the world's literature in mass concrete materials, properties, construction methods, and tests; concrete composition, chemistry and physics of concrete and concreting materials; analytical procedures and test methods, portland cement grout mixtures. Services include specific items of evaluated data, current summaries or technical trends, comprehensive state-of-the-art analyses, and specialized advisory services.

Cultural Information Analysis Center
Address:
American University
Center for Research in Social Systems
5010 Wisconsin Ave, NW
Washington, D. C 20016
Director:
James R. Price
Phone: (202) 244–7300, Ext. 272
DOD Cognizance:
Robert F. Chailllet
Scientific & Technical Information Div.
Army Research Office
Washington, D. C. 20315
Phone: (202) 694–1144

Provides a system with a rapid response capability for storing, retrieving and analyzing information for specific customer requests in the social sciences areas, regarding peoples, their societies, environments and behavior patterns The center responds to requests from government agencies and their qualified contractors by providing analytical information, in-depth studies, annotated bibliographies, consultant services and reviews. Input is collected from the information base provided by the extensive cross-cultural research program in the social sciences conducted by the Center for Research in Social Systems, as well as from information collected from academic, government and other research organizations and individuals.

DASA Information and Analysis Center
Address:
General Electric—TEMPO
816 State St.
Santa Barbara, Calif. 93102
Director:
Warren W. Chan
Phone: (805) 965–0551, Ext 501
DOD Cognizance:
Lt. Colonel J. D. Brown, USA
Chief, Atmospheric Effects Div.
Defense Atomic Support Agency (DASA)
2020 14th St. N.
Arlington, Va. 22201

Serves as a collection point and reference center for all technical information pertinent to the effects of nuclear explosions. Its services are available to all responsible agencies and individuals conducting scientific investigations into the nature of nuclear weapon effects and their implications on present effects and their implications on present and future military systems. The center provides access to data from a wide variety of sources; announces, through its own publications, projected data collection programs, theoretical investigations, and experiments; frees other agencies from the responsibility for servicing requests for data; and forms a permanent archive of these data.

Defense Ceramic Information Center
Address:
Battelle Memorial Institute
505 King Ave.
Columbus, Ohio 43201
Director:
Winston Duckworth
Phone. (614) 299–3151, Ext. 475
DOD Cognizance:
Barry R. Emrich
Air Force Materials Laboratory
Wright-Patterson AFB, Ohio 45433

Collects, interprets and disseminates technical information about ceramics, primarily for structural and thermal-protective applications in military systems The services of the center include answering technical inquiries, providing technical advisory services, and publishing data compilations, critical technical reviews, news of developments, and lists of accessions

Defense Metals Information Center
Address:
Battelle Memorial Institute
505 King Ave.
Columbus, Ohio 43201
Director:
Roger J Runck
Phone: (614) 299–3151, Ext. 668
Point of Contact:
Roy Endebrock
Phone: (614) 299–3151, Ext. 2926
DOD Cognizance:
Edward Dugger
Air Force Materials Laboratory (MAAM)
Wright-Patterson AFB, Ohio 45433

Collects, interprets and disseminates scientific and closely related materials. Subjects covered are properties, fabrication and application of aluminum, titanium, beryllium, magnesium, tungsten, molybdenum, columbium, tantalum, rhenium, stainless steels, hot-work die steels, low-alloy hardenable steels, nickel-base superalloys, cobalt-base superalloys, and non-base superalloys. Provides answers to technical questions; information concerning current research and development projects and scientific or technical data or data compilations upon request. There is no organized loan service. Makes technical evaluation of the accuracy, quality and significance of information that has already been introduced into the system. Prepares state-of-the-art reviews, correlations of information, etc.; and provides technical consultant services.

Electronic Properties Information Center
Address:
Hughes Aircraft Co.
Centinela Ave. & Teale St.
Culver City, Calif 90230
Director:
Dr. Sheldon J. Welles
Phone: (213) 391–0711, Ext. 6596
DOD Cognizance:
R. F. Klinger
Air Force Materials Laboratory (MAAM)
Wright-Patterson AFB, Ohio 45433

Provides ready access to literature and experimental data relating to the electrical and electronic properties of all materials of importance in today's technology. Subjects covered are semiconductors, insulators, electroluminescent materials, thermionic emitters, ferroelectrics, ferrites, ferromagnetics, superconductors, metals, ceramics, electronic materials and documentation of electronic properties. Literature is abstracted and indexed into an automated search system. Data from the literature are evaluated and compiled into series of data sheets. Summary and state-of-the-art reports are also issued. Abstracts, which are included with requests for bibliographies, identify the materials and indicate the experimental data contained in the literature Requests for specific or related data are likewise honored.

Great Lakes Physical Information Analysis Center
Address:
Lake Survey District
Corps of Engineers
630 Federal Bldg.
Detroit, Mich. 48226
Director:
Ronald J. Walton
Phone: (313) 622–6959
DOD Cognizance:
DOD Instruction 5100.45, July 28, 1964

Conducts selective acquisition, technical review and analysis, storage and retrieval, and dissemination of Great Lakes physical information to user-oriented agencies as directed.

Human Engineering Information and Analysis Service
Address:
Tufts University
Systems Bldg.
Medford, Mass. 02155
Director:
Dr. Paul G. Ronco
Phone: (617) 623–6802
DOD Cognizance:
Dr. Leon Katchmar
Systems Research Laboratory
Human Engineering Laboratory
Aberdeen Proving Ground, Md. 21005
Phone: (301) 278–4401

Conducts document acquisition; abstracting and coding of documents; preparation of indexing or categorizing schemes, and dissemination of human factors information in the form of user products such as an annual annotated bibliography of the literature, special bibliographies covering specific topic areas, and critical reviews of topic areas.

Hydraulic Engineering Information Analysis Center
Address:
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631
Vicksburg, Miss 39180
Director:
Ellis B. Pickett
Phone: (601) 636–3111, Ext. 368
DOD Cognizance:
Office, Chief of Engineers (ENGSA)
Washington, D. C. 20315

Acquires, analyzes, evaluates and condenses the world's literature on river, harbor and tidal hydraulics; flow through pipes, conduits, channels and spillways as related to flood control and navigation; hydraulic design and performance of dams, locks, channels and other structures; and water waves and underwater shock effects. Services include specific items of evaluated data, current summaries or technical trends, comprehensive state-of-the-art analyses, and specialized advisory services.

Infrared Information and Analysis Center
Address:
University of Michigan
Institute of Science and Technology
Box 618
Ann Arbor, Mich. 48107
Director:
Thomas Limperis
Phone: (313) 483–0500, Ext. 281

DOD Cognizance:
F. B Isakson
Code 421 (Physics Branch)
Office of Naval Research
Washington, D C. 20360
Phone: (202) 696-4332

Collects, analyzes and disseminates information on infrared physics and technology (including such areas as solid state physics, radiation physics and optics, infrared detectors, atmospheric phenomena, information processing, military infrared equipment, and industrial and medical infrared). Services include the publication of quarterly annotated bibliographies, state-of-the-art reports, the proceedings of the infrared information symposia, the sponsorship of symposia, and provision of library and consultation services.

Mechanical Properties Data Center
Address:
Belfour Stulen, Inc.
13919 W. Bay Shore Drive
Traverse City, Mich. 49684
Director:
A. J. Belfour
Phone: (616) 947-4500
DOD Cognizance:
Richard Klinger
Air Force Materials Laboratory (MAAM)
Wright-Patterson AFB, Ohio 45433

Prepares and distributes raw and evaluated strength data of materials on a periodic basis and in response to specific questions. Operates a system for storage, retrieval, evaluation and presentation of materials test information. Subjects covered are mechanical properties of structural materials with primary emphasis on metals, plastics secondary, including test procedures, material formulation, processing and environments; and includes statistical evaluation of data. Prepares and disseminates the Aerospace Structural Metals Handbook.

Military Entomology Information Service
Address:
Armed Forces Pest Control Board
Forest Glen Section
Walter Reed Army Medical Center
Washington, D. C. 20012
Director:
Lt. Colonel Daniel J. Reynolds, MSC, USA
Phone: (202) 576-5365
DOD Cognizance:
Armed Forces Pest Control Board

Organizes information relating to military entomology and associated fields, and provides for its storage and retrieval. Responds to requests from individuals or organizations for specific information on military entomology, and automatically distributes periodically annotated bibliographic citations of special accessions.

National Oceanographic Data Center
Address:
Navy Yard Annex, Bldg. 160
Washington, D. C. 20390
Director:
Dr. Thomas S. Austin
Phone: (202) 698-2249
DOD Cognizance:
Naval Oceanographic Office
Suitland, Md. 20391

Serves as an interagency activity supported by 10 Federal agencies and is primarily a central repository for the nation's oceanographic data. Receives, compiles, processes and preserves oceanographic data for rapid retrieval, and prepares data summaries, tabulations and atlases showing annual, seasonal, and monthly oceanographic conditions.

Nondestructive Testing Information Analysis Center
Address:
Army Materials & Mechanics Research Center
Watertown, Mass. 02172
Director:
Charles P. Merhib
Phone: (617) 926-1900, Ext 265 or 507
DOD Cognizance:
Army Materials & Mechanics Research Center

Collects, maintains and disseminates information in the field of nondestructive testing. Disseminates information upon request to government installations and others. Publishes newsletters and report guides to literature in various sub-fields of nondestructive testing. Renders technical advice and assistance upon request.

Pavements and Soil Trafficability Information Analysis Center
Address:
U. S. Army Engineer Waterways Experiment Station
P O. Box 631
Vicksburg, Miss. 39180
Director:
W. J. Turnbull
Phone: (601) 636-3111, Ext. 234
DOD Cognizance:
Chief of Engineers (ENGSA)
Washington, D. C. 20315

Acquires, analyzes, evaluates and condenses world's literature in subjects of flexible and rigid pavements, expedient surfacing, surface vehicle mobility and trafficability research, ground flotation, and research in terrain evaluation as relevant primarily to military needs. Services include specific items of evaluated data, current summaries or technical trends, comprehensive state-of-the-art analyses, and specialized advisory services.

Plastics Technical Evaluation Center
Address:
Picatinny Arsenal, Bldg. 3401
Dover, N. J. 07801
Director:
Harry E. Pebly Jr.
Phone: (201) 328-4222
DOD Cognizance:
Dr. Peter R. Kosting
Army Materiel Command
Washington, D. C. 20315

Collects and evaluates technical information on plastic materials and application of interest to DOD. Distributes information to DOD activities, their designees, or other organizations with demonstrable defense supporting interests upon request. Renders technical advice and assistance on plastics to DOD activities upon request.

Radiation Effects Information Center
Address:
Battelle Memorial Institute
505 King Ave.
Columbus, Ohio 43201
Director:
Donald J. Hamman
Phone: (614) 299-3151, Ext. 2553
DOD Cognizance:
Defense Atomic Support Agency
2020 14th St. N.
Arlington, Va. 22201

Collects, screens and analyzes information on radiation effects on a wide range of materials and devices. Prepares state-of-the-art review reports, memoranda, and accession lists. Provides inquiry answering service on specific technical questions. Provides personal access to information for representatives of government agencies and their contractors, with need to know and appropriate security clearance.

Reliability Analysis Center
Address:
IIT Research Institute
10 W. 35th St.
Chicago, Ill. 60616
Director:
George Jacobi
Phone: (312) 225-9630
DOD Cognizance:
Milton Haus
Rome Air Development Center (EMERR)
Griffiss AFB, N. Y. 13440
Phone: (315) 330-2020

Collects, stores, organizes, reviews, assesses, analyzes and disseminates information and experience data bearing on reliability of microelectronic devices and semiconductor transistors and diodes, and the influence and contribution of part design, material, manufacturing techniques, processing, configuration, testing practices, screening practices and electrical and environmental stresses on the nature of failures encountered during fabrication, testing and operation. Emphasis is placed upon those parts and devices which are expected to be used in future design of DOD equipment and which will be of most immediate significance to electronic government-industry complex. Provides answers to technical questions and consultant services. Prepares data compilations, reliability notebooks, monographs, abstracts, and bibliographies.

Remote Area Conflict Information Center
Address:
Battelle Memorial Institute
505 King Ave.
Columbus, Ohio 43201
Director:
J. Tuck Brown
Phone: (614) 299-3151, Ext. 3116
DOD Cognizance:
Fred Koether
Advanced Research Projects Agency
Department of Defense
Washington, D. C. 20301
Phone: (202) 697-8904

Collects, stores and disseminates information on overseas defense research, emphasizing the physical and engineering sciences aspects. Provides functional information system required to monitor research in counterinsurgency. Performs analyses and issues state-of-the-art reports and technical summaries.

Shock & Vibration Information Center
Address:
Naval Research Laboratory
Code 6020
Washington, D. C. 20390
Director:
Dr. W. W. Mutch
Phone (202) 767-2220
DOD Cognizance:
Office of Naval Research
Washington, D. C. 20360

Serves DOD, National Aeronautics and Space Administration, and their contractors by collection, correlation and dissemination of needed information on the environmental factors shock and vibration.

Soil Mechanics Information Analysis Center
Address:
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631
Vicksburg, Miss. 39180

Director:
A A Maxwell
Phone: (601) 636-3111, Ext. 497
DOD Cognizance:
Chief of Engineers (ENGSA)
Washington, D. C. 20315

Acquires, analyzes, evaluates and condenses literature on the subjects of soil mechanics soil physics, engineering geology, and embankment and foundation engineering, as related to stability and dynamics of foundations, structures, navigation and flood control, erosion, shock attenuation, and load carrying Services include specific items of evaluated data, current summaries or technical trends, comprehensive state-of-the-art analyses, and specialized advisory services.

Thermophysical Properties Research Center
Address:
Purdue University
Research Park
2595 Yeager Road
W. Lafayette, Ind. 47906
Director:
Dr. Y. S. Touloukian
Point of Contact:
W. H. Shafer
Technical Inquiry Coordinator
Phone. (317) 743-3827
DOD Cognizance:
John Charlesworth
Air Force Materials Laboratory (MAAM)
Wright-Patterson AFB, Ohio 45433

Provides scientific and technical information based on critical evaluation of previous data and, if necessary, new measurements and/or calculations in the thermophysical properties field. Conducts experimental research on new determinations to fill in gaps and to reconcile discordant data of the thermophysical properties. Major reference works are available through commerical publishers and information services are available upon request.

VELA Seismic Information and Analysis Center
Address:
University of Michigan
P. O. Box 618
Ann Arbor, Mich, 48107
Director:
Robert Lormand
Phone: (313) 483-0500, Ext. 294
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Collects, processes and disseminates seismic and related information for the VELA UNIFORM program. Analyzes information and issues technical summaries and state-of-the-art reports. Prepares special bibliographies, information digests and monographs.

Plastics Analysis Center

(Continued from page 28)

vised every three years. The latest revision is presently under way, with publication (as Note 6B) expected also early in 1969.

The other guides also evolved from recognition of a general need. The glossary (Note 14) is a consensus of the opinions of what the terms relating to plastics mean. It would be of no great help to the specialist, but of considerable value to anyone new (or occasional) in the field. It has been quite well received by sales personnel.

The guide to test methods (Note 17) is a rearrangement of the normal "test method subject" order into "subject-test method" order. It tells where to look for a ready-made test method to suit the need.

As for the list of trade designations (Note 9), it is recognized that although the list was quite authoritative at time of compilation, it was probably somewhat dated by the time it came off the press. The center maintains a write-in list of new trade names (based on Note 9) with possible publication of a revision in future. However, since trade names do get into military drawings, and since the trade designations get pushed into the background by newer materials, the PLASTEC note stands helpful to the succeeding generations.

To receive notice of PLASTEC publications in particular areas of interest, companies should file a Field-of-Interest Register form with the center. This form may be requested from PLASTEC, Picatinny Arsenal, Dover, N.J. 07801.

In the past the inquiry services and reports of PLASTEC (and other DOD centers) have been available without cost to qualified government contractors and suppliers. However, the Office of the Director of Defense Research and Engineering has requested that the centers plan an orderly transition to a schedule of charges for services, and initiate such a program before the end of FY 1969.

While brief and simple questions will still be answered free, there will be a charge, based on the hours used in retrieving and analyzing information for detailed inquiries. State-of-the-art reports and other formal publications will also be sold at a price designed to assure recovery of publication costs.

Air Force Awards FX Radar Contracts

The Air Force has awarded contracts to Westinghouse Electric Corp., Baltimore, Md., and Hughes Aircraft Co., Culver City, Calif., for competitive development of a new attack radar system for the FX advanced tactical air superiority fighter.

The contracts will total about $22 million during FY 1969 and FY 1970, including an initial obligation of $3,941,500 to each contractor. The winner from this 20-month competitive development program will be selected after both radar prototypes are flight tested and results are evaluated.

First Flight Test for Beryllium Rudder

A lightweight beryllium rudder attached to an Air Force F-4 fighter aircraft has successfully sustained flight loads of 190 percent of the structure's design limit.

The test marked the first time that a large structure of high strength-to-weight beryllium had been tested in actual flight.

McDonnell Douglas Corp., St. Louis, Mo., built and is testing the rudder for the Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio.

Laboratory officials report that the rudder not only successfully sustained 190 percent of the design limit load for vertical fin and rudder bending, but also successfully held up under design limit loads about the hinge moment (side to side forces). The two forces acted upon the rudder at the same time during actual flight.

Nearly 43 hours of flight tests have been recorded on the beryllium rudder and tests will continue through 60 hours. Prior to flight tests, the rudder successfully passed a 50,000 cycle balance weight fatigue test, and checkout on three flight simulation static tests.

Although beryllium is four times as stiff and 30 percent lighter than aluminum, its use has been restricted because of its low ductility, high cost and poor machining qualities.

Weight of the beryllium rudder used in the tests was about 42 pounds. Similar rudders made of aluminum weigh about 64 pounds. Tests are expected to continue through early 1969.

DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of November 1968.

DEFENSE SUPPLY AGENCY

4—Hunt Wesson Foods, Inc., Fullerton, Calif. $1,113,771. 258,806 cases of tomato catsup. Defense Personnel Support Center, Philadelphia, Pa. DSA 137-69-C-CA97.

5—Rolane Sportswear, Inc., Ridgely, Tenn. $1,081,614. 178,653 coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0760.

—Apparel Corp. of America, Knoxville, Tenn. $1,201,317. 188,000 coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0761.

—Alpha Industries, Inc., Knoxville, Tenn. $1,470,184. 240,830 coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0762.

6—Burlington Industries, New York, N.Y. $1,569,200. 2,000,000 yards of wind resistant poplin rip-stop cotton cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0785.

—C. M. London Co., New York, N.Y. $1,697,400. 2,000,000 yards of wind-resistant poplin rip-stop cotton cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0786.

—Reeves Bros., Inc., New York, N.Y. $1,026,000. 1,200,000 yards of wind-resistant poplin rip-stop cotton cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0787.

—Putnam Mills, New York, N.Y. $1,234,090. 601,000 linear yards of nylon ballistic cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0657.

—Sportwelt Shoe Co., Nashua, N.H. $1,007,109. 166,528 pairs of combat boots. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0775.

7—General Foods Corp., White Plains, N.Y. $1,069,455. Instant rice. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-M060.

8—Burlington Industries, New York, N.Y. $1,554,880. 452,000 yards of serge polyester wool cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0697.

13—Raymond Corp., Rockville, Md. $1,151,969. Electric fork lift trucks. Defense General Supply Center, Richmond, Va. DSA 400-69-C-2461.

14—J. P. Stevens & Co., New York, N.Y. $3,489,960. 4,000,000 yards of wind-resistant cotton poplin cloth. Defense Personnel Center, Philadelphia, Pa. DSA 100-69-C-0847.

—Prestex, Inc., New York, N.Y. $1,185,990. 1,300,000 yards of wind-resistant cotton poplin cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0846.

—Marion Mfg. Co., Marion, N.C. $1,160,000. 1,400,000 yards of wind-resistant cotton poplin cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0848.

—Iselin Jefferson Co., New York, N.Y. $1,468,927. 1,604,000 yards of wind-resistant cotton poplin cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0845.

15—Ojus, Inc., Miami, Fla. $3,029,563. 100,000 rolls of barbed concertina tape and 56,708 cases of barbed tape. Defense Construction Supply Center, Columbus, Ohio.

—The Defense Fuel Supply Agency, Alexandria, Va., has awarded the following nine contracts for JP-5 jet fuel:

Mobil Oil Corp., New York, N.Y. $11,148,480. 109,500,000 gallons. DSA 600-69-D-0898.

Humble Oil & Refining Co., Houston, Tex. $10,557,500. 96,500,000 gallons. DSA 600-69-D-0896.

Douglas Oil Co., Los Angeles, Calif. $2,895,900. 23,000,000 gallons. DSA 600-69-D-0888.

Powerine Oil Co., Sante Fe Springs, Calif. $2,715,860. 20,000,000 gallons. DSA 600-69-D-0901.

Sun Oil Co., Philadelphia, Pa. $2,217,600. 20,160,000 gallons. DSA 600-69-D-0902.

Phillips Petroleum Co., Bartlesville, Okla. $1,652,275. 12,470,000 gallons. DSA 600-69-D-0900.

Hess Oil & Chemical Co., Woodbridge, N.J. $1,165,500. 10,500,000 gallons. DSA 600-69-D-0895.

Fletcher Oil & Refining Co., Wilmington, Calif. $1,704,537. 12,500,000 gallons. DSA 600-69-D-0890.

Beacon Oil Co., Hanford, Calif. $1,103,254. 8,100,000 gallons. DSA 600-69-D-0887.

—The Defense Fuel Supply Agency, Alexandria, Va., has awarded the following 42 contracts for JP-4 jet fuel:

Humble Oil & Refining Co., Houston, Tex. $32,832,243. 327,822,000 gallons. DSA 600-69-D-0846.

Standard Oil Co., San Francisco, Calif. $25,113,790. 212,616,400 gallons. DSA 600-69-D-0874.

Mobil Oil Corp., New York, N.Y. $21,971,453. 196,500,000 gallons. DSA 600-69-D-0856.

Coastal States Petrochemical Co., Houston, Tex. $12,044,386. 117,140,000 gallons. DSA 600-69-D-0825.

Continental Oil Co., Houston, Tex. $11,517,429. 114,527,000 gallons. DSA 600-69-D-0827.

American Oil Co., Chicago, Ill. $9,467,395. 89,865,000 gallons. DSA 600-69-D-0810.

Sun Oil Co. Philadelphia, Pa. $8,412,980. 79,400,000 gallons. DSA 600-69-D-0876.

Cities Service Oil Co., New York, N.Y. $8,008,039. 81,865,000 gallons. DSA 600-69-D-0824.

Phillips Petroleum Co., Bartlesville, Okla. $7,089,430. 60,160,000 gallons. DSA 600-69-D-0864.

Ashland Oil & Refining Co., Ashland, Ky. $6,711,315. 65,180,000 gallons. DSA 600-69-D-0814.

Golden Eagle Refining Co., Los Angeles, Calif. $6,029,796. 49,350,000 gallons. DSA 600-69-D-0840.

Delta Refining Co., Memphis, Tenn. $4,733,275. 45,230,000 gallons. DSA 600-69-D-0829.

Getty Oil Co., New York, N.Y. $4,619,538. 42,571,000 gallons. DSA 600-69-D-0838.

Fort Worth Refining Co., Houston, Tex. $4,605,342. 45,000,000 gallons. DSA 600-69-D-0837.

Fletcher Oil & Refining Co., Wilmington, Calif. $4,277,016. 34,500,000 gallons. DSA 600-69-D-0836.

Adobe Refining Co., Midland, Tex. $3,918,280. 34,825,000 gallons. DSA 600-69-D-0807.

American Petrofina Co., Dallas, Tex. $3,564,057. 36,117,000 gallons. DSA 600-69-D-0811.

MacMillan Ring-Free Oil Co., Los Angeles, Calif. $3,583,731. 29,307,000 gallons. DSA 600-69-D-0854.

Diamond Shamrock Corp., Amarillo, Tex. $3,347,548. 30,193,000 gallons. DSA 600-69-D-0831.

Southwestern Oil & Refining Co., Corpus Christi, Tex. $3,281,040. 33,600,000 gallons. DSA 600-69-D-0872.

Signal Oil & Gas Co., Houston, Tex. $2,953,500. 30,000,000 gallons. DSA 600-69-D-0868.

Hess Oil & Chemical Co., Woodbridge, N.J. $2,651,375. 27,626,400 gallons. DSA 600-69-D-0844.

Tesoro Petroleum Corp., San Antonio, Tex. $2,504,869. 21,500,000 gallons. DSA 600-69-D-0879.

Atlantic Richfield Co., Los Angeles, Calif. $2,488,344. 20,160,000 gallons. DSA 600-69-D-0815.

Douglas Oil Co., Los Angeles, Calif. $2,456,000. 20,000,000 gallons. DSA 600-69-D-0832.

Sinclair Refining Co., New York, N.Y. $2,462,040. 25,200,000 gallons. DSA 600-69-D-0869.

Sioux Oil Co., Newcastle, Wyo. $2,450,000. 20,000,000 gallons. DSA 600-69-D-0870.

Leonard Refineries, Alma, Mich. $2,436,866. 23,090,000 gallons. DSA 600-69-D-0853.

Tonkawa Refining Co., Houston, Tex. $2,114,881. 20,000,000 gallons. DSA 600-69-D-0881.

Edgington Oil Refineries, Long Beach, Calif. $2,103,719. 17,000,000 gallons. DSA 600-69-D-0833.

Kern County Refinery, Los Angeles, Calif. $2,090,868. 16,720,000 gallons. DSA 600-69-D-0850.

Okmulgee Refining Co., Okmulgee, Okla. $1,791,317. 19,070,000 gallons. DSA 600-69-D-0860.

Southwestern Pallet Co., Abilene, Tex. $1,582,818. 15,650,000 gallons. DSA 600-69-D-0873.

Crystal Flash Petroleum Corp., Indianapolis, Ind. $1,584,759. 18,750,000 gallons. DSA 600-69-D-0828.

Hunt Oil Co., Dallas, Tex. $1,064,800. 11,000,000 gallons. DSA 600-69-D-0847.

Famariss Oil & Refining Co., Hobbs, N.M. $1,037,440. 8,000,000 gallons. DSA 600-69-D-0835.

Monarch Refining Co., San Antonio, Tex. $1,037,086. 9,000,000 gallons. DSA 600-69-D-0858.

Southland Oil Co., Yazoo City, Miss. $1,028,469. 9,839,000 gallons. DSA 600-69-D-0871.

Bayou Refining Co., Pasadena, Tex. $1,560,490. 15,750,000 gallons. DSA 600-69-D-0817.

Cardinal Transports, Inc., San Antonio, Tex. $1,158,525. 11,000,000 gallons. DSA 600-69-D-0821.

Husky Oil Co., Denver, Colo. $1,124,199. 10,643,000 gallons. DSA 600-69-D-0848.

Hercules Oil Co., Long Beach, Calif. $1,100,081. 8,783,000 gallons. DSA 600-69-D-0843.

18—Sinclair Refining Co., New York, N.Y. $1,238,741. 2,599,500 gallons of gasoline, 1,852,000 gallons of diesel fuels and 5,334,800 gallons of fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0694.

—Kern County Refinery, Los Angeles, Calif. $1,119,158. 8,000,000 gallons of JP-5 jet fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0897.

19—The Defense Fuel Supply Center, Alexandria, Va., has awarded the following three contracts for JP-4 jet fuel:

Gulf Oil Corp., New York, N.Y. $9,595,684. 89,418,000 gallons. DSA 600-69-D-0842.

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company — Value — Material or Work to be Performed—Location of Work Performed (if other than company plant) — Contracting Agency—Contract Number.

Union Oil Co., Los Angeles, Calif. $8,198,336. 66,028,200 gallons. DSA 600-69-D-0883.

Triangle Refineries, Houston, Tex. $2,317,768. 21,060,000 gallons. DSA 600-69-D-0882.

—The Defense Fuel Supply Agency, Alexandria, Va. has awarded the following contracts for JP-5 jet fuel:

Golden Eagle Refining Co., Los Angeles, Calif. $4,924,882. 36,750,000 gallons. DSA 600-69-D-0891.

Gulf Oil Corp., New York, N.Y. $8,769,093. 36,868,150 gallons. DSA 600-69-D-0892.

20—The Defense Fuel Supply Center, Alexandria, Va. has awarded the following five contracts for JP-4 jet fuel:

Good Hope Refineries, Houston, Tex. $4,590,000. 45,000,000 gallons. DSA 600-69-D-0841.

Texaco, Inc., New York, N.Y. $3,814,020. 37,800,000 gallons. DSA 600-69-D-0880.

Bell Oil & Gas Co., Bartlesville, Okla. $3,735,988. 38,488,000 gallons. DSA 600-69-D-0819.

Standard Oil Co., Cleveland, Ohio. $1,034,550 9,500,000 gallons. DSA 600-69-D-0875.

Sunray DX Oil Co., Tulsa, Okla. $2,861,300. 31,130,000 gallons. DSA 600-69-D-0877.

—Johnson & Johnson, New Brunswick, N.J. $1,776,093. 2,456,242 packages of surgical sponges. Defense Personnel Support Center, Philadelphia, Pa. DSA 120-69-C-1591.

21—Choctaw Mfg. Co., Silas, Ark. $1,129,000. 529,244 pairs of white trousers. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-0861.

22—Gulf Oil Corp., Houston, Tex. $2,254,662. 12,724,000 gallons of gasoline, 2,815,000 gallons of diesel fuel and 206,000 gallons of fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0197.

25—Howell Refining Co., San Antonio, Tex. $3,018,372. 27,000,000 gallons of JP-4 jet fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69D0845.

—Alabama Refining Co., Theodore, Ala. $1,913,057. 19,350,000 gallons of JP-4 jet fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0808.

—The following four contracts have been awarded by the Defense General Supply Center, Richmond, Va., for chemical aluminum powder:

Alcan Aluminum Co., Elizabeth, N.J. $2,964,616. 9,347,000 lbs. DSA 400-70-C-2928.

Aluminum Co. of America, Pittsburgh, Pa. $22,463,072. 72,100,000 lbs. DSA 400-69-C-2932.

Reynolds Metal Chemical Co., Richmond, Va. $1,564,300. 4,950,000 lbs. DSA 400-69-C-2931.

Valley Metallurgical Co., Essex, Conn. $2,981,892. 10,045,800 lbs. DSA 400-69-C-2925.

26—Atlantic Richfield Co., Philadelphia, Pa. $4,441,668. 42,000,000 gallons of JP-4 jet fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0816.

29—American Oil Co., Chicago, Ill. $8,647,695. 13,857,400 gallons of gasoline, 3,632,000 gallons of diesel and 7,058,000 gallons of fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0160.

—Hotchkiss Timer, Inc., Hotchkiss, Colo. $2,495,799. 281,693 wooden pallets. Defense General Supply Center, Richmond, Va. DSA 400-69-C-3061.

DEPARTMENT OF THE ARMY

1—AVCO Corp., Stratford, Conn. $1,297,654. Housing assemblies for UH-1 helicopters. Aviation Materiel Command, St. Louis, Mo. AF-41-608-67-A-3234.

—Philco Ford Corp., Newport Beach, Calif. $27,154,000. Chaparral fire units and weapon system test equipment. Anaheim, Calif. Army Missile Command, Huntsville, Ala. DA AH01-69-C-0368.

—TRW, Inc., Redondo Beach, Calif. $2,000,000. $1,500,000. Classified research and development. Electronics Command, Fort Monmouth, N.J.

—Ford Motors, Highland Park, Mich. $2,069,350. M151A1 utility trucks. General Purpose Vehicle Project Manager, Warren, Mich. DA AE06-68-C-0001.

—Hercules, Inc., Wilmington, Del. $4,753,820. M4 electrical blasting caps. Port Ewen, N.Y. Picatinny Arsenal, Dover, N.J. DA AA21-69-C-0020.

—Brown Engineering Co., Huntsville, Ala. $1,361,852. Technical support of the Sentinel Program. Sentinel Systems Command, Hunstville, Ala. DA HC60-69-C-0024.

—Baldwin Construction Co., Marysville, Calif. $4,684,000. Construction of a 100-bed hospital and 16-chair dental facility at Mather AFB, Calif. Engineer Dist., Sacramento, Calif. DA CA05-69-C-0027.

4—E. J. Walters Co., Elk Grove Village, Ill. $1,815,447 Metal parts for fuze bodies. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0237.

—General Motors, Cleveland, Ohio. $1,688,600. Engineering design portion of Phase II of the productability cost reduction study for the Main Battle Tank. Fort Detrick, Md. DA AK13-68-C-0145.

—Sperry Rand Corp., Phoenix, Ariz. $1,223,522 (contract modification) Compass set component parts Army Procurement Agency, Pasadena, Calif. DA AG07-68-C-1290.

5—Chamberlain Mfg. Corp., Elmhurst, Ill. $13,580,900. Metal parts for 155mm projectiles. Scranton, Pa. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0187.

—Z-D Products, Costa Mesa, Calif. $2,016,000. 7.62mm ammunition links. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-V-0213.

6—Crown Construction Co., Columbus, Ga. $3,134,761. Construction of 200 units of family housing with supporting utilities at Fort Benning, Ga Engineer Dist., Savannah, Ga DA CA21-69-C-0026

—Pace Corp., Memphis, Tenn $2,336,560 (contract modification). Flares Picatinny Arsenal, Dover, N.J. DA AA21-68-C-0497.

—Bell Aerospace Corp., Fort Worth, Tex. $1,072,000. Modification kits for AH-1G helicopters Hurst, Tex. Aviation Materiel Command St Louis, Mo. DA AJ01-68-A-0022.

7—Hamilton Watch Co., Lancaster, Pa. $10,848,196 Fuzes. East Petersburg, Pa Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0252.

—Bell Aerospace Corp., Fort Worth, Tex $4,104,000. AH-1G helicopters. Hurst, Tex. Aviation Materiel Command, St. Louis, Mo DA AJ01-69-C-0252

—Cooper-Bessemer Co., Mt. Vernon, Ohio. $4,055,825. Diesel-engine generator units and auxiliaries for Sentinel sites. Grove City, Pa. Engineer Dist., Huntsville, Ala. DA CA87-69-C-0008.

8—Mason & Hanger, Silas Mason Co., Lexington, Ky $23,920,918 (contract modification). Production of bombs, mines and support services Grand Island, Neb Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-68-C-0333.

—Norris Industries, Los Angeles, Calif. $3,393,000 (contract modification). Metal parts for 175mm projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-68-C-0520.

—Amron Corp., Waukesha, Wis. $1,202,569. Metal parts for 40mm projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0244.

—Harvey Aluminum, Inc., Torrance, Calif. $1,201,200. Metal parts for 40mm projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0109.

—Intercontinental Mfg. Co., Garland, Tex. $2,250,000 (contract modification). Metal parts for 152mm projectiles. Picatinny Arsenal, Dover, N.J. DA AA21-67-C-0598.

12—Lockheed Aircraft, Burbank, Calif. $2,810,068. Rotary wing blades, hydramatic servo cylinders and transmissions for AH-56A helicopters. Van Nuys, Calif. Aviation Materiel Command, St. Louis, Mo. DA AJ01-68-A-1749.

13—Olin Mathieson Chemical Corp., New Haven, Conn. $1,088,791. 45-cal. cartridges. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0220.

—Studebaker Corp., Minneapolis, Minn. $2,338,830 (contract modification). 60KW generator sets Mobility Equipment Research & Development Center, Fort Belvoir, Va. DA AK02-67-C-0136.

—Litton Systems, Sunnyvale, Calif. $2,192,000 (contract modification). Scientific and technical effort for the Combat Development Engineering Command. King City, Calif. Army Procurement Agency, Oakland, Calif. DA AG05-67-C-3096.

14—Brunswick Corp., Sugar Grove, Va. $3,158,560 (contract modification). 16-tube, 35mm cartridge launchers. Edgewood Arsenal, Md DA 18-035-AMC-00962.

—Honeywell, Inc., New Brighton, Minn. $2,949,475 Bomb fuzes. Army Procurement Agency, Chicago, Ill. DA AA09-68-C-0490.

15—Colt's Inc., Hartford, Conn. $30,312,461 (contract modification). M16, 5.56mm rifles and M16A1, 5.56mm rifles. Army Weapons Command, Rock Island, Ill. DA AF03-69-C-0021.

—Garrett Corp., Phoenix, Ariz. $1,633,41- (contract modification). Repair parts for self-contained transportable medical units Mobility Equipment Command, St. Louis, Mo. DA AK01-68-C-3858

—Stewart-Warner Corp., Lebanon, Ind. $1,948,991. 60mm projectile metal parts. Army Procurement Agency, Chicago, Ill DA AA09-69-C-0040.

—Booz-Allen Applied Research, Inc., Chicago, Ill $1,796,020 (contract modification). 850 man months of scientific and technical effort and other support services in support of studies and analysis of military doctrine programs for the Combat Developments Command. Fort Leavenworth, Kan Army Procurement Agency, Oakland, Calif. DA AG05-67-C-0437.

—Norris Industries, Los Angeles, Calif. $1,195,183 (contract modification). 152mm projectiles. Army Procurement Agency, Pasadena, Calif. DA AG07-68-C-1257.

—Crowell Constructors, Fayetteville, N.C. $1,179,748. Construction of a runway and taxiway with all supporting utilities at Pope AFB, N.C. Engineer Dist., Savannah, Ga. DA CA21-69-C-0029.

—Western Electric, New York, N.Y. $1,095,120. Nike-Hercules technical publications. Winston-Salem and Burlington, N.C. Army Missile Command, Huntsville, Ala DA AH01-69-C-0760.

—Amron Corp., Waukesha, Wis. $3,136,635. Metals parts for M43A1 grenades. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0272.

—Bulova Watch Co., Jackson Heights, N.Y. $1,832,292. Metal parts for 81mm mortar fuzes. Valley Stream, N.Y. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0056.

—AVCO Corp., Richmond, Ind. $1,749,965 (contract modification). Metal parts for general purpose bomb adapter boosters. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0119.

—Harvey Aluminum, Inc., Torrance, Calif. $1,745,560. Metal parts for 40mm practice projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill DA AA09-69-C-0276.

18—Rulon Co., Chicago, Ill $7,430,500. Metal parts for artillery shell fuzes Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0266.

—Hensel Phelps Construction Co., Greeley, Colo. $3,119,200. Construction of a 1,000-man dormitory at Lowry AFB, Colo. Engineer Dist., Omaha, Neb. DA CA45-69-C-0023.

—Phillips Broadcase Equipment Corp., Paramus, N.J. $2,375,000. Far infrared target indicators. Mobility Equipment Command, Fort Belvoir, Va. DA AK02-69-C-0186.

—General Construction Co., Fargo, N.D. $1,490,266. Construction on the Port Arthur Hurricane Protection Project, In Texas. Engineer Dist., Galveston, Tex DA CW69-C-0036.

19—Whittaker Corp., Columbus, Ohio. $2,463,920. Metal parts for 81mm cartridge fuzes. Westerville and Columbus, Ohio. Ammunition Procurement & Supply Agency. Joliet, Ill. DA AA 9 68-C-0276.

—Bethlehem Steel, Bethlehem, Pa. $1,692,702 (contract modification). 175mm gun

tubes. Watervliet Arsenal, N.Y. DA AF07-68-C-0153.

—S. Tepfer & Sons, Deer Park, N.Y. $1,315,279 (contract modification). Metal parts for Shillelagh missile warhead sections Ammunition Procurement & Supply Agency Joliet, Ill. DA AA09-68-C-0450.

—Chrysler Corp., Warren, Mich. $2,858,918. Combat tanks and armed vehicle launcher bridges. Warren, Mich., Dayton, Ohio, and Eynon, Pa. Army Weapons Command, Rock Island, Ill. DA AF03-68-C-0002.

—I.D. Precision Components Corp., Jamaica, N.Y. $1,176,000. Metal parts for artillery ammunition fuzes Gadsden, Ala. Ammunition Procurement & Supply Agency, Joliet, Ill.

20—Norris Industries, Los Angeles, Calif. $11,140,421 Metal parts for 105mm cartridge cases Riverbank, Calif. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0181.

—Standard Container Co., Montclair, N.J $4,845,000. Metal ammunition boxes for small arms. Homerville, Ga. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0185.

—Hughes Aircraft Co., Culver City, Calif. $2,214,952 (contract modification). Electronic items for Iroquois helicopters Electronics Command, Fort Monmouth, N.J. DA AB07-68-C-0188.

—Philco Ford Corp., Newport Beach, Calif. $1,728,508. 30mm guns without barrels for Cheyenne AH-56A helicopters. Anaheim, Calif. Army Weapons Command, Rock Island, Ill DA AF03-69-C-0033.

—Schlumberger, Ltd., Archbald, Pa. $1,611,000. Logic test set computers used to test the gun direction computer on the field artillery digital automatic computer. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0235.

21—Dynalectron Corp., Washington, D.C. $8,071,879. Data collection services for missiles in flight and other test vehicles White Sands Missile Range, N.M. DA AD07-69-C-0032.

22—Hansel-Phelps Construction Co. and Penner Construction Co., Greeley, Colo. $13,125,000. Construction of 10 enlisted men's barrack complexes and a road extension at Fort Riley, Kan. Engineer Dist., Kansas City, Kan. DA CA41-69-C-0030.

—Brunswick Corp., Sugar Grove, Va. $8,054,400. CS filled canisters. Edgewood Arsenal, Md. DA AA15-69-C-0279.

—Wilkinson Mfg. Co., Fort Calhoun, Neb. $1,921,500. 60mm mortar fin assemblies. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0282

—Associated Spring Association, Bristol, Conn. $1,862,623. 5.56mm cartridge clip and filler magazines. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0238.

—Rohm & Haas Co., W. Philadelphia, Pa. $1,800,000. Solid propellant research. Huntsville, Ala. Army Missile Command, Huntsville, Ala. DA AH01-69-C-0772.

—Wire & Metal Specialties Corp., Warren, Mich. $1,749,126. 5.56mm cartridge clips. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0239.

—John R. Hollingsworth Co., Phoenixville, Pa. $1,338,918. Generator sets. Mobility Equipment Command, St Louis, Mo. DA AK01-68-C-8526.

25—Philco-Ford Corp., Newport Beach, Calif. $1,464,046 (contract modification). Continuation of a development/improvement program for the 30mm automatic weapon. Rock Island Arsenal, Rock Island, Ill. DA AF01-68-C-0687.

—Bethlehem Steel, Bethlehem, Pa. $2,156,107. Rough machined, alloy steel forging tubes for 175mm guns. Watervliet Arsenal, Watervliet, N.Y. DA AF07-69-C-0018.

26—Day & Zimmermann, Inc., Philadelphia, Pa. $4,701,581 (contract modification). Loading, assembling, and packing miscellaneous items of ammunition and components Texarkana, Tex. Ammunition Procurement & Supply Agency, Joliet, Ill. CPAF DA-11-173-AMC-00114(A).

—U.S. Plastic Moulding, Inc., Wallingford, Conn. $1,208,840. Metal parts for 40mm projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0279.

—Continental Motors, Muskegon, Mich. $2,411,330. Engine assemblies for M60 tanks Tank Automotive Command, Warren, Mich DA AE07-69-C 0534

—AVCO Corp., Stratford, Conn. $35,949,200 (contract modification). Turbine engines Stratford, Conn, and Charleston, S.C. Aviation Materiel Command, St. Louis, Mo. DA AJ01-68-C-1874.

27—United Aircraft, Stratford, Conn $3,000,000 Main rotor heads and gear boxes for CH-54 helicopters. Aviation Materiel Command, St Louis, Mo. DA 23-204-AMC-03369.

—Philips Broadcast Equipment Corp., Paramus, N.J. $1,214,120. Short range handheld viewers for the Night Vision Program. Mobility Equipment Command Research & Development Center Fort Belvoir, Va. DA AK02-69-C-0199.

—UNECO, Inc., Bellevue, Neb. $3,932,372. Delay plungers for M557 fuzes. Ammunition Procurement & Supply Agency, Joliet, Ill DA AA09-69-C-0289

—American Bosch Arma Corp., Springfield, Mass. $1,485,367. Metering fuel pumps with compensators for 2½-ton trucks. Tank Automotive Command, Warren, Mich. DA AE07-69-C-0513.

—Deep South Construction Co., Montgomery, Ala $3,189,156. Runway and road extension construction, exterior and interior underground electrical work, and excavation work Columbus AFB, Miss and Hamilton Field, Ala. Engineer Dist, Mobile, Ala. DA CA01-69-C-0017.

29—Heyle & Patterson, Inc., Cocoa, Fla $1,825,283 Construction of environment shelter for launch complex 40. Patrick AFB, Fla. Engineer Dist, Cape Canaveral, Fla. DA CA13-69-C-0008.

—Federal Cartridge Corp., Anoka, Minn. $3,119,397. 5 56mm ball cartridges. Frankford Arsenal, Philadelphia, Pa DA AA25-69-C-0084.

—Whittaker Corp., Saugus. Calif $2,351,160 Igniters for 2 75-inch rockets Indio, Calif Picatinny Arsenal, Dover, N.J. DA AA21-69-C-0310.

—Aerojet General, Downey, Calif. $1,212,855. Bomb dispensers. Army Procurement Agency, Pasadena, Calif. DA AA09-69-C-0025.

—Collins Radio Co., Dallas, Tex $1,114,500 Radio sets. Electronics Command, Philadelphia, Pa. DA AB05-67-C-0181.

—Raytheon Co., Norwood, Mass $3,822,000. Telephone signal converters. North Dighton, Mass Electronics Command, Philadelphia, Pa DA AB05-67-C-1011.

—Chrysler Outboard Corp., Hartford, Conn. $4,127,652. 1, 1½ and 3 horsepower standard military engines. Mobility Equipment Command, St. Louis, Mo DA AK01-69-C-3413.

—Kaiser Jeep Corp., Toledo, Ohio $10,009,217. 2½-ton trucks. General Purpose Vehicle Project Manager, Warren, Mich. DA AE06-68-C-0007.

—Bendix Corp., Teterboro, N.J. $2,150,000. Ten sets of stabilized platform and amplifier control power supply for Pershing missile systems. Army Procurement Agency, New York, N.Y. DA AG25-68-A-0955.

—Hayes International Corp., Birmingham, Ala. $1,275,300. M151 warheads for 2.75-inch rockets. Army Procurement Agency, Cincinnati, Ohio. DA AA09-69-C-0185.

—Pullman Corp., Chicago, Ill. $3,296 475. Semi-trailers with Bogie assemblies. West Point, Pa and Freemont, Calif Tank Automotive Command, Warren, Mich DA AE07-69-C-1103.

—Baifield Industries, Dallas, Tex. $2,354,000 Demountable body vans Shreveport, La. Tank Automotive Command, Warren, Mich. DA AE07-69-C-1104.

—Rohm & Haas Co., Philadelphia, Pa. $1,600,000. Propellant research. Huntsville, Ala Army Missile Command, Huntsville, Ala. DA AH01-69-C-0853.

—Philco-Ford Corp., Newport Beach, Calif. $3,807,453 FY 1969 engineering services for the Chaparral missile. Army Missile Command, Huntsville, Ala DA AH01-69-C-0845.

—Atlantic Research Corp., Alexandria, Va. $1,655,834. Loading of rocket motors for Redeye weapons system. Gainesville, Va. Army Missile Command, Huntsville, Ala. DA AH01-69-C-0598.

—Sanders Associates, Bedford, Mass. $7,200,000. Production of forward area alerting radar and test equipment. Army Missile Command, Huntsville, Ala. DA AH01-69-C-0749.

—Hughes Aircraft, Culver City, Calif. $55,371,527. Production of TOW missiles and related hardware. Tucson, Ariz. and El Segundo, Calif. Army Missile Command, Huntsville, Ala. DA AH01-68-C-2141.

—Farmers Chemical Association, Inc., Tyner, Tenn. $1,801,800. Mixed acids. Chattanooga, Tenn Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00300 (A).

—Hercules, Inc., Wilmington, Del. $9,892,021 (contract modification). Production of 2.75-inch rocket propellant and support services. Lawrence, Kan. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00042 (A).

—Olin Mathieson Chemical Corp., New York, N Y $6,809,076 (contract modification). Production of various propellants and support services Baraboo, Wis. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0014.

—General Motors, Detroit, Mich. $5,363,276 Metal parts for 105mm projectiles and modernization and support activites. St. Louis, Mo. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-67-C-0025.

—Atlas Chemical Industries, Wilmington, Del. $16,362,194 (contract modification) TNT and support services at the Army Ammunition Plant, Chattanooga, Tenn. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00531 (AA)

—Norris Industries, Los Angeles, Calif. $6,071,681 (contract modification). Continued maintenance of facility and activation of production lines for the 5-inch Navy shell at the Army Ammunition Plant, Riverbank, Calif; $2,143,478. M374 metal parts for 81mm projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00998 (A). DA AA09-69-C-0290

—Bulova Watch Co., Providence, R.I. $2,660,000. Head assemblies for M525 fuzes. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0271.

—Eureka-Williams Co., Bloomington, Ill $6,579,166. Metal parts for 750-lb. bombs. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0068.

—Weatherhead Co., Cleveland, Ohio. $2,376,862 (contract modification). Metal parts for 105mm projectiles. Army Procurement Agency, Chicago, Ill. DA AA09-C 01115

—Honeywell, Inc., Hopkins, Minn. $7,095,579 (contract modification). M551 fuzes for 40mm cartridges New Brighton, Minn. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0046.

—Weatherhead Co., Cleveland, Ohio. $2,554,750. Metal parts for 4.2-inch projectiles Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0081.

—ACF Industries, Inc., St Louis, Mo. $1,099,800 M52 fuze bodies for M525 fuzes. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0145.

—Hercules, Inc., Wilmington, Del. $1,407,841. M6 blasting caps. Port Ewen, N.Y. Army Procurement Agency, Chicago, Ill. DA AG11-69-C-0325.

—Westinghouse Air Brake Co., Peoria, Ill. $3,263,841 Model 440HA road graders. Indianapolis, Ind. Army Mobility Equipment Command, St. Louis, Mo. DA 23-195-AMC-01083 (T).

DEPARTMENT OF THE NAVY

1—Frequency Engineering Laboratories, Farmingdale, N.J. $11,032,865. Production of basic point defense surface missile system. Naval Ordnance Systems Command. N00017-68-C-4404.

—General Electric, Washington, D.C. $2,606,000. Poseidon weapon training system services and material. Pittsfield, Mass. Strategic Systems Project Office. N00030-69-C-0128.

—Norfolk Shipbuilding & Dry Dock Co., Norfolk, Va. $2,389,800. Regular overhaul of the land ship dock USS Spiegel Grove (LSD-32). Supervisor of Shipbuilding, Conversion & Repair, Fifth Naval Dist., Norfolk, Va.

—RCA, Van Nuys, Calif. $2,310,000. Classified electronic counter-measure equipment Naval Ship Systems Command. N00024-69-C-1094.

—Carrier Corp., Syracuse, N.Y. $1,497,034. Conditioning absorption plants for nuclear submarines. Naval Ship Systems Command. N00024-69-C-5215.

—Martec, Inc., Decatur, Ala $1,401,872. Shipping and storage containers for missiles. Naval Air Systems Command. N00019-69-C-0218.

4—Clevite Corp., Cleveland, Ohio $10,000,000. Performance of studies to establish a basis for engineering development of a MK 48, MOD 1, torpedo and to fabricate and conduct engineering tests on development prototype models. Naval Ordnance Systems Command. N00017-67-C-1206.

—Clymer Machine Co., Trumbauersville, Pa. $1,776,600 Fuses to be used in the 5-inch, 38-cal. gun loading program. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0131.

—Metals Engineering Co., Greenville, Tenn. $1,742,851 Fin assemblies for MK 84, MOD 0, 2000-lb. bombs. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0130.

5—U.S. Steel, Pittsburgh, Pa. $38,616,500. 500-lb bombs. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0141.

—Saboca, Pittsburgh, Pa $1,378,785. Carbon steel bars for use in M48 fuzes. Naval Ordnance Station, Forest Park, Ill. N00419-69-C-0155.

6—Whittaker Corp., Saugus, Calif. $11,011,460. Aircraft parachute flares. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0154.

—Kilgore Corp., Toone, Tenn. $6,528,012. Parachute flares. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0152.

—FMC Corp., Minneapolis, Minn. $2,905,627. Production of 5"/54 Cal. gun mounts, and related equipment Fridley, Minn. Naval Ordnance Systems Command. N00017-68-C-4211.

7—North American Rockwell Corp., Columbus, Ohio. $19,260,000 (contract modification). T-2C aircraft. Naval Air Systems Command. N00019-68-C-0346.

—General Dynamics, Pomona, Calif. $12,045,210 (contract modification) Standard Arm missiles. Naval Air Systems Command. N00019-68-C-0074

—United Aircraft, Stratford Conn. $7,500,000 (contract modification). Long lead time effort and materials in support of planned procurement of CH-53A helicopters. Naval Air Systems Command. NOw-63-0150.

—PRD Electronics, Westbury, N.Y. $6,674,931 (contract modification). VAST building blocks and data transfer unit. Naval Air Systems Command. N00019-68-C-0449.

—Palmetto Construction Co., Charleston, S.C. $1,286,368. Construction of a maintenance dock for large aircraft. Charleston, S.C. Southeast Div., Naval Facilities Engineering Command, Charleston, S.C. N62467-67-C-0385.

—J. Ray McDermott & Co., New Orleans, La. $1,107,131. Procurement of monomooring fueling buoys at the CB Center, Port Hueneme, Calif. Southwest Div., Naval Facilities Engineering Command, San Diego, Calif. N62473-69-C-0009.

8—General Electric, Schenectady, N.Y. $9,486,000. Nuclear propulsion components. Naval Ship Systems Command. N00024-67-C-5321.

12—Norris Industries, Inc., Los Angeles, Calif. $15,149,360. MK 10, MOD 0, and MK 9, MOD 0, cartridge cases. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0126.

—United Aircraft, Hartford, Conn. $1,023,610. Modification kits for J-52P8A engines used on A-4 and A-6 aircraft. Aviation Supply Office, Philadelphia, Pa. N00383-9-6900A-AF895.

—Sperry Rand Corp., Great Neck, N.Y. $1,138,219 Equipment, instrumentation and control services. Naval Ship Systems Command N00024-69-C-0248.

14—Norris Industries, Los Angeles, Calif. $53,182,140. MK 82, MOD 1, 500-lb. bomb bodies. Navy Ships Parts Control Center, Mechanicsburg Pa. N00104-69-C-0134.

—General Electric, Schenectady, N.Y. $8,200,000. Nuclear propulsion research and development. Naval Ship Systems Command. N00024-67-C-5016.

—Propulsion Systems, Inc., Port Washington, N.Y. $6,476,387. Gas turbine propulsion system production King of Prussia, Pa. Naval Ship Systems Command N00024-69-C-5226

—Atlas Fabricators, Inc, Long Beach, Calif. $1,603,362. MK 12 pallets used in 5-inch gun programs and MK 82 and MK 83 bomb programs. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0165.

—Yuba Industries, Inc., Benicia, Calif. $1,683,840. Truck cover assemblies for catapults. Naval Supply Center, Oakland, Calif. N00228-69-C-0772.

—Chrysler Corp., Detroit, Mich. $1,150,818. Design and construction of 10 riverine utility river craft(RVC). Naval Ship Systems Command N00024-69-C-0216.

—G. C. Dewey Corp., New York, N.Y. $1,011,682. Electronic countermeasure systems. Naval Electronic Systems Command. N00039-69-C-3519.

—Electromagnetic Technology Corp., Lansdale, Pa. $1,268,400. Manufacture of low frequency transmitting sets Colmar, Pa Naval Electronic Systems Command. N00039-69-C-1546.

—Uniroyal, Inc., Providence, R.I. $2,049,739. Rubber cement shipping containers. Naval Facilities Engineering Command. N62578-69-C-0014

—Woods Hole Oceanographic Institution, Woods Hole, Mass. $1,100,000. Surveys and analyses of ocean characteristics pertaining to acoustic transmission. Office of Naval Research.

19—Northwest Marine Iron Works, Portland, Ore. $1,390,826. Overhaul, drydocking, improvement of crew and sponsor personnel quarters and other repairs and alterations to the USNS General H. H. Arnold. Military Seal Transportation Service

—Curtiss-Wright Corp., Wood-Ridge, N.J. $1,050,136. Spare parts to maintain and overhaul R1820 engines. Aviation Supply Office, Philadelphia, Pa. F41608-67-A-5900 GBNU.

20—Pennsylvania State University, University Park, Pa $7,465,000. MK 48 torpedo research and development. Naval Ordnance Systems Command. NOw65-0128-d.

21—Beech Aircraft, Wichita, Kan. $1,466,100 (contract modification). AQM-37A targets. Naval Air Systems Command. N00019-69-C-0174.

22—Johns Hopkins University Applied Physics Laboratory, Silver Spring, Md. $23,181,800. Bumblebee research and development. Naval Ordnance Systems Command. NOw 62-0604c.

—Westinghouse Electric, West Mifflin Borough, Pa. $9,725,000. Nuclear propulsion research and development. Naval Ship Systems Command. N00024-67-C-6016.

—General Instrument Corp., Chicopee, Mass. $8,354,000. Bomb fuzes. Naval Air Systems Command. N00019-69-C-0277.

—TRW Systems, Washington, D.C. $8,267,968. Engineering services for an anti-submarine warfare systems project. Naval Ordnance Systems Command. N00017-69-C-1411.

—RCA, Princeton, N.J. $7,775,171. Navigation satellites. Strategic Systems Project Office. N00030-68-C-0092.

25—Lockheed Aircraft, Sunnyvale, Calif. $16,299,088. Sentinel system test target program. Strategic Systems Project Office. N00030-68-C-0308.

—Raytheon Co., Sudbury, Mass. $7,925,000. Guidance system electronic assemblies and components for Poseidon missiles. Strategic Systems Project Office. N00030-69-C-0127.

26—Raytheon Co., Lexington, Mass. $9,070,994. Guidance and control components for Sparrow III missiles. Lowell, Mass. Naval Air Systems Command. N00019-69-C-0031.

27—Raytheon Co., Portsmouth, R.I. $32,500,000. Sonar systems for eight attack submarines. Naval Ship Systems Command. N00024-69-C-1006.

—LTV Aerospace Corp., Dallas, Tex. $56,688,991 (contract modification). A-7D aircraft. Naval Air Systems Command. N00019-67-C-0143.

—General Electric, West Lynn, Mass. $3,789,655. Spare parts for aircraft engines. Aviation Supply Office, Philadelphia, Pa. F34601-68-D-2463-GB29.

—Bayfield Industries, Dallas, Tex. $2,662,500. MK 15, MOD 2, retard bomb fins. Carrollton, Tex. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0180.

—Palmetto Construction Co., Charleston, S.C. $2,469,711 Construction of an aircraft hanger at Charleston AFB, S.C. Naval Facilities Engineering Command. N62467-67-C-0383

—Bunker Ramo Corp., Silver Spring, Md. $1,835,000 External stores systems for electronic equipment. Canoga Park, Calif. Navy Air Development Center, Johnsville, Pa. N62269-68-C-0836.

—Caidan Co., Los Angeles, Calif. $1,409,000. Construction of a research and development building. China Lake, Calif. Naval Facilities Engineering Command N62473-67-C-3138.

—Phoenix General Construction Co., Dallas, Tex. $1,371,914. Construction on a vertical missile packaging building at the Naval Weapons Station, Charleston, S.C. Naval Facilities Engineering Command N62467-68-C-0175.

—Hercules, Inc., Wilmington, Del. $1,106,381. Solid propellant research and development. Cumberland, Md. Naval Ordnance Systems Command. N00017-69-C-4405.

DEPARTMENT OF THE AIR FORCE

1—Wall Colomony Corp., San Antonio, Tex. $1,607,011. Repair of jet engine parts. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41608-69-D-0623-0001.

—Perkin-Elmer Corp., Norwalk, Conn. $1,774,600. Production of camera systems for RA-5C aircraft. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-0867.

—Honeywell, Inc., Hopkins, Minn. $24,015,000. Production of land mines and associated equipment. Armament Development Test Center, Eglin AFB, Fla. F08635-69-C-0015.

4—AVCO Corp., Wilmington, Mass. $5,495,000. Development and production of missile penetration aids. Space & Missile Systems Organization, (AFSC), Norton AFB, Calif. F04701-68-C-0021-P011.

—General Electric, Arkansas City, Kan. $3,441,986. Overhaul and modification of J-85 engines and components. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F34601-68-C-3937.

—General Electric, West Lynn, Mass. $2,000,000 (contract modification). Component improvement program for T-64 aircraft engines. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-0713-P008.

—United Aircraft of Canada, Longueuil, Quebec, Canada. $2,270,393. Spare parts applicable to R4360 aircraft engines. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. N383-93300A.

5—Boeing Co., Wichita, Kan. $2,000,000. Modification kits for B-52 aircraft. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F34601-69-C-0690.

—Lear Siegler, Inc., Santa Monica, Calif. $1,088,415. Production of flight control systems. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0340.

—Westinghouse Electric Corp., Baltimore, Md. $3,941,500. Development of attack radar for the F-X aircraft. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0550.

—Hughes Aircraft, Culver City, Calif. $3,941,500. Development of attack radar for the F-X aircraft. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0549.

7—Oshkosh Truck Corp., Oshkosh, Wis. $1,292,750. Remanufacture of an estimated

159 snow removal vehicles to a like-new configuration Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga F09603-69-D-0002.

—**North American Rockwell Corp.**, Tulsa, Okla. $1,207,000 Overhaul and repair of air ground missiles. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F04601-68-C-4486.

—**United Aircraft**, Windsor Locks, Conn $1,418,345 Modification and/or overhaul of propeller hub and blade assemblies for C-130A/D aircraft. East Granby, Conn Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-69-D-0296 (0001).

—**United Aircraft**, East Hartford, Conn $1,024,480. Production of spare parts for J-57 aircraft engines. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. N383 69000A.

8—**Dynamics Corp. of America**, Garden City, N Y. $3,956,013. Production of kits for the modification of radar bombing systems Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-67-C-1676 P012.

—**Browning Construction Co.**, San Antonio, Tex $1,933,000. Construction of 100 family housing units at Laughlin AFB, Tex. Laughlin AFB, Tex. F41685-69-C-0047.

12—**Chromally American Corp.**, San Antonio, Tex. $1,551,192. Repair and application of protective metallic coating on compressor blades for J57 and J75 aircraft engines. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41608-68-D-1617-0012.

—**General Electric**, Ontario, Calif. $1,570,-797. Overhaul and modification of J-79 engines. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F34601-69-C-0261.

—**Northrop Corp.**, Hawthonre, Calif. $8,-467,000. FY 1969 procurement of F-5 aircraft. Aeronautical Systems Div, (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-1036-P0001.

13—**Lockheed Aircraft**, Marietta, Ga. $2,-489,804. Specialized engineering services for C-130 fatigue analysis programs Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-68-C-1335-P003.

—**General Dynamics**, Fort Worth, Tex. $2,-360,192. A combat operational training test and evaluation radar set. Rome Air Development Center, Griffiss AFB, N.Y. F30602-69-C-0070.

14—**General Electric**, West Lynn, Mass. $6,-080,000. Production of T-64 turb shaft engines for HH-53 helicopters. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-0468-P007.

—**R. G. LeTourneau, Inc.**, Longview, Tex. $1,121,749. Model 88 truck lifts, accessories and spare parts. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41608-69-D-6604-001.

15—**Lockheed Aircraft**, Marietta, Ga. $7,704,-218. Engineering, design fabricat'on and installation of a modified wing in C-130 B/E aircraft. Warner-Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-68-C-2530-P001.

18—**Hughes Aircraft**, Fullerton, Calif. $7,-720,000. Development of a sensor reporting post including a computer program and related service. Electronics Systems Div., (AFSC), L. G. Hanscom Field, Mass.

—**United Aircraft**, East Hartford, Conn, $5,725,337. Production of spare parts for J-57 aircraft engines. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. N383 69000A.

—**Tasker Industries**, Van Nuys, Calif. $1,-828,087. Development of a radar system for Air Defense. Armament Development & Test Center, Eglin AFB, Fla. F08635-69-C-0100.

20—**Itek Corp.**, Palo Alto, Calif. $3,605,875. Production of radar warning and homing equipment. Sunnyvale, Calif. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F04606-67-A-1818.

21—**Varo, Inc.**, Garland, Tex. $2,901,420. Production of ejection racks for F-100 aircraft. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-69-C-1481.

—**Marwais Steel Co.**, Richmond, Calif. $2-342,215. Production of steel arch aircraft shelters 2750th Air Base Wing, Wright-Patterson AFB, Ohio F33601-68-C-1135

—**Brooks & Perkins, Inc.**, Detroit, Mich. $1,788,000 Production of large pallets used with the mechanized loading and unloading of air cargo. Cadillac, Mich. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-69-A-0039.

—**Control Data Corp.**, Minneapolis, Minn $1,552,840. Rental and maintenance of automatic data processing equipment Cape Kennedy Air Force Station, Fla and Patrick AFB, Fla Air Force Eastern Test Range, Fla F08650-69-M-9984.

—**Bunker-Ramo Corp.**, Canoga Park, Calif $1,449,977 Production of display consoles. Rome Air Development Center, Griffis AB, N.Y. F30602-68-C-0221.

22—**Lockheed Aircraft**, Marietta, Ga $38,916,-780 Production of C-130E aircraft Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0249

—**General Electric**, West Lynn, Mass. $12,-999,200. Production of turboshaft engines Aeronautical Systems Div, (AFSC), Wright-Patterson AFB, Ohio F33657-69-C-0124-P001.

—**Preston Dairy Products**, Bunkburnett, Tex $1,665,368 Dairy products for troop issue, hospital, and resale requirements for Lackland AFB, Kelly AFB, and Brooks AFB, Tex San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41615-69-C-70154.

25—**North American Rockwell Corp.**, Anaheim Calif. $14,500,000. Production of post boost propulsion subsystems for Minuteman III missiles. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif F04701-68-C-0280.

—**Hughes Aircraft**, Culver City, Calif. $1,000,000. Development of a radar system Aeronautical Systems Div, (AFSC), Wright-Patterson AFB, Ohio. F33651-69-C-1148.

26—**Honeywell, Inc.**, Hopkins, Minn. $12,209-000. Production of bomb components. Armament Development & Test Center, Eglin AFB, Fla. F08635-69-C-0018.

—**Department of Public Works**, Anchorage, Alaska. $1,622,659. Conveyance, disposal and treatment of sewage at Elmendorf AFB, Alaska Base Procurement Office, Elmendorf AFB, Alaska. AF65501-69-C-0358.

—**Avco Corp.**, Everett, Mass. $1,142,000 Operation and maintenance of airborne optical equipment. Space & Missile Systems Div., (AFSC), Norton AFB, Calif F04701-69-C-0102.

27—**Batesville Mfg. Co.**, Batesville, Ark. $1,-181,293 Production of bomb components Armament Development Test Center, Eglin AFB, Fla. F33657-68-C-0850.

—**Automatic Switch Co.**, Florham Park, N.J $2,325,624. Production of automatic electrical switching units. DACA 13-69-C-0003.

—**Republic Electric & Development Co.**, Washington, Ill. $1,149,296. Production of diesel engine generator control assemblies. DACA 13-69-C-0002.

29—**Litton Systems**, Woodland Hills, Calif. $6,349,977. Production of avionics subsystems for F-4 aircraft. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-0294.

—**Continental Aviation & Engineering Corp.**, Detroit, Mich. $1.483,875. Production of J69 aircraft engines. Toledo, Ohio. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-0294.

—**General Electric**, West Lynn, Mass, $24,-586,800 Turboshaft engines for T-2C aircraft. Aeronautical Systems Div., (AFSC). Wright-Patterson AFB, Ohio. F33657-69-C-0005-P001.

—**IBM Corp.**, Cape Kennedy, Fla. $1,481,-674. Rental and maintenance of automatic data processing equipment at Patrick AFB, Fla. Air Force Eastern Test Range, (AFSC), Patrick AFB, Fla. F08650-69-C-0085.

—**Gary Aircraft Corp.**, Victoria, Tex. $1,-755,275. Inspection and repair of C-54 aircraft. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-69-C-0036.

Small Business Size

(Continued from page 16)

consideration to the submissions and to any oral presentations which it wishes to hear, and then presents a written recommendation to the Administrator. The Administrator's decision is based upon the entire record, with due consideration to the advice of the board. When a conclusion is reached, all parties concerned are informed of the results and of the reasoning behind the decision.

The number of size appeal cases decided annually since the board was established in 1961 has fluctuated, but the general trend has been upward. During FY 1962, the first full year of operation, 30 cases were decided. Since that time the case load has increased to 51 in FY 1968, with a high of 61 in FY 1967. Over approximately seven and a half years, a total of 322 cases have been handled by the Appeals Board.

The figures cited verify the recognition by SBA of the issue of relativity in size determinations mentioned at the beginning of this article. Every appeal processed is an assurance that unique situations will not be ignored; every change in the standards or procedures is recognition that business and its environment is in a constant state of change. SBA strives to remain aware of those changes and to keep its size standards, which are relative, in consonance with reality. Because of this responsiveness to business conditions, defense-oriented firms may find themselves, their competitors, or their subcontractors qualified for special programs of assistance. It is always worth knowing that your firm is entitled to something new.

Changing Address?

The *Defense Industry Bulletin* converted to a computer-prepared mailing list a few months ago. Now, when requesting a change in address or a deletion, subscribers must send the mailing label from the back cover of the magazine. Without this label, changes in address or deletions cannot be effected. Changes and labels should be sent to the Editor, Defense Industry Bulletin, OASD (Public Affairs), Room 1E764, The Pentagon, Washington, D.C. 20301.

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Navy Given Go-Ahead on "Quiet" Submarine Program

The Defense Department has given permission for the Navy to proceed with building a nuclear-propelled, turbine electric drive submarine, Secretary of Defense Clark M. Clifford announced.

He explained that two new attack submarines had been proposed. One is a new, high-speed submarine. "It will not only be fast, it also will be quiet and will carry the most effective weapons and other devices procurable," he said. On July 1, 1968, he ordered this submarine to be built.

The turbine electric drive submarine, the so-called "quiet" submarine is a different program with different objectives. The program calls for construction of one boat. The "quiet" submarine will have a new kind of propulsion system, and newer and quieter machinery.

"Quietness is a great advantage in a submarine. The quieter it is, the better it can perform any function without being detected and destroyed by an enemy," Secretary Clifford explained. "Future U.S. submarines will emphasize quietness to an even greater extent than do our existing designs—which are the quietest in the world."

Achieving quietness is an art. Various quieting devices must be tried in an actual submarine to accurately assess their value. The turbine electric drive submarine will permit testing of various combinations of quieting measures that can be used in other submarines if found to be effective.

"The submarine built will be more than a test bed," Mr. Clifford said. "It will carry weapons and other devices and should provide us with a very silent and useful operational submarine."

Electric Boat Division, General Dynamics Corp., Groton, Conn., was authorized $22 million by the Navy to plan for and procure materials and equipment for construction of the submarine, SSN-685.

Cost of the "quiet" submarine is estimated at $150 million to $200 million, compared with about $78 million for a new Sturgeon class nuclear attack submarine. Concurrently, the Navy is working on 29 additional Sturgeon class submarines.

U.S. and U.K To Combine Fuel Cell Research

The United States and the United Kingdom have agreed to cooperate on power generating fuel cells research. The countries will pool efforts to achieve a better understanding of the fundamental processes involved in fuel cell systems.

Areas of research will center principally on optimum choice of materials for use as anodes, cathodes, electrolytes, and fuels, and the most efficient structure to use these materials.

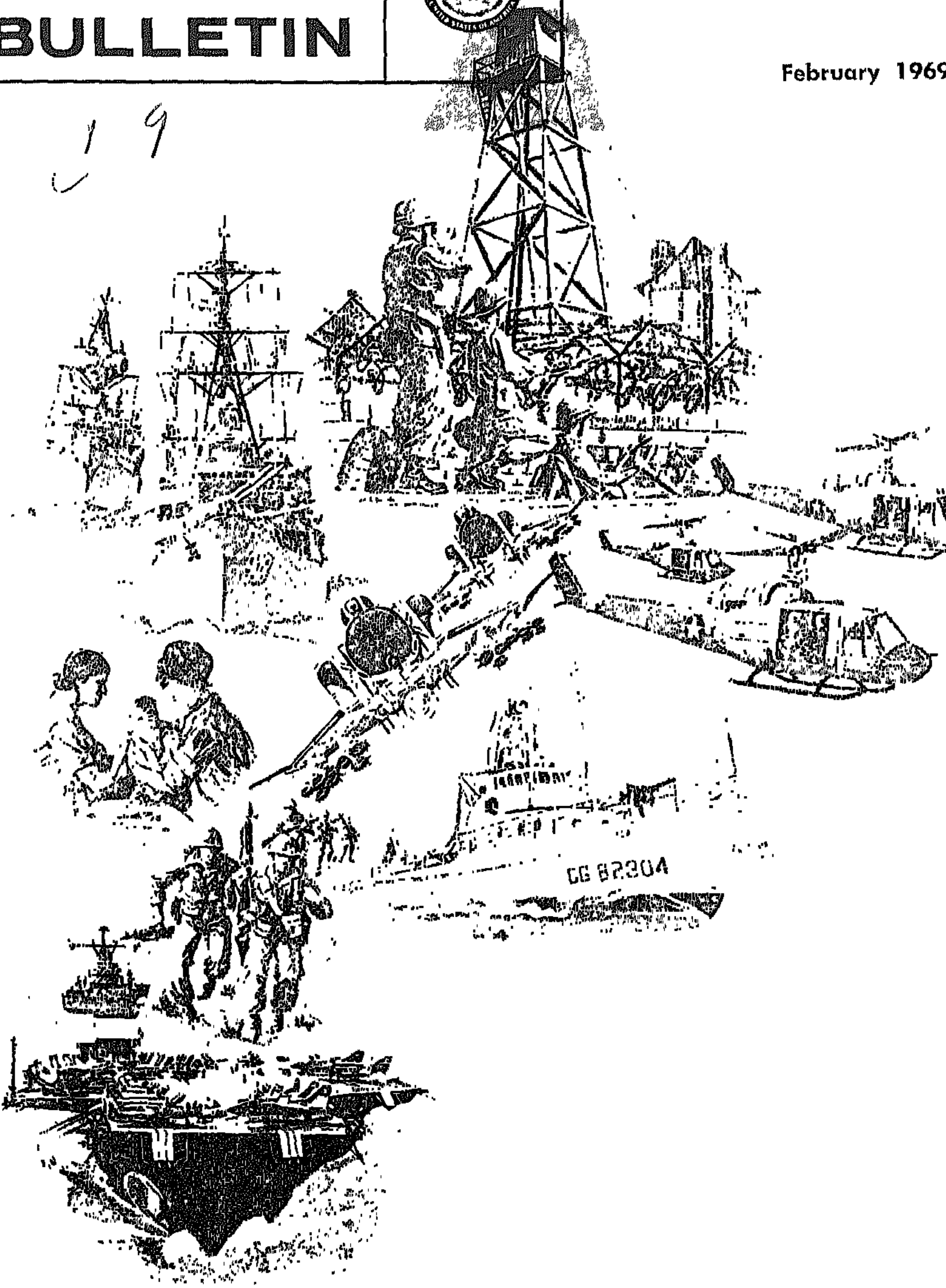
Both countries have been conducting extensive research and development work in fuel cells for some time. The new agreement formalizes collaboration by the two governments. Work will center on efforts to design more economical and effective fuel cell systems.

The program is expected to run for three years. Work will be performed through contracts with university and industrial laboratories, and in government facilities.

The U.K. Ministry of Defence (Navy Department) and the U. S. Army are directing the program for their respective countries.

DEFENSE INDUSTRY BULLETIN

February 1969



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The *Bulletin* serves as a means of communication between the Department of Defense and its authorized agencies, defense contractors and other business interests. It serves as a guide to industry concerning official DOD policies, programs and projects and seeks to stimulate thought on the part of the Defense-Industry team in solving problems related to the defense effort.

Suggestions from industry representatives concerning possible topics for future issues are welcome and should be forwarded to the Editor at the address shown below.

The *Bulletin* is distributed free of charge to qualified representatives of industry and of the Departments of Defense, Army, Navy, and Air Force. Subscription requests should be submitted on company letterhead stationery, must indicate the position title of the requestor and be addressed to the Editor, Defense Industry Bulletin, OASD (PA), Pentagon, Washington, D. C. 20301.

Contents of this magazine may be freely reprinted. Mention of the source will be appreciated.

IN THIS ISSUE

FEATURES

DEPARTMENTS

Logistic support and services for the Armed Forces are the Defense Supply Agency missions. A series of articles on the material supply and logistics organizations of the Military Departments begins with the DSA article on page 12.

The Role of "Need-To-Know" in Releasing Classified Information

C. Donald Garrett

The "need-to-know" principle is a vital part of the Government's security of information program. The necessity for ensuring the free interchange of classified scientific and technical information throughout the scientific and technical community raises continuing problems and unique need-to-know situations. It is the purpose of this article to discuss the various aspects of the principle and to suggest some of the considerations involved.

Section 7, Executive Order 10501, Nov. 5, 1953, states in pertinent part:

> Knowledge or possession of classified defense information shall be permitted only to persons whose official duties require such access in the interest of promoting national defense and only if they have been determined to be trustworthy.

This establishes the basis for the need-to-know concept.

The Defense Department, in Subsection VII.D, Enclosure 1 to DOD Directive 5200.1, "Safeguarding Official Information in the Interests of the Defense of the United States," July 10, 1968, states it this way:

> The dissemination of classified information orally, in writing, or by any other means, shall be limited to those persons whose official duties require knowledge or possession thereof.

This is need-to-know.

Subsection VII.D states further:

> The final responsibility for determining whether a person's official duties require that he possess or have access to any element or item of classified information, . . . rests upon each individual who has authorized possession, knowledge, or control of the information involved and not upon the prospective recipient.

This shows clearly that the responsibility of determining need-to-know rests solely with the person who has the classified information. The prospective recipient may be called upon to show the nature of his need, but the holder decides whether the need is sufficient to permit release of the classified information.

There are certain overall restrictions on releases, even though the holder recognizes an established need-to-know.

- **Security clearance.** Before classified information is released, the recipient must be known to have been cleared under procedures, policies and standards relating to trustworthiness established by the Government.
- **Third-agency rule.** Information that does not belong to the holder (information that is under the classification jurisdiction of another government agency) can be released to a third party (someone outside both agencies involved) only with the consent of the "owner" of the classified information. In this connection the entire Defense Department is one agency and the third-agency rule does not apply within DOD, except when the "owner" of the classified information specifically restricts release within his DOD component (Military Department or Defense Agency).
- **Statutory limitations.** Proprietary rights and trade secrets are protected by law, and releases of classified information cannot be made in violation of those rights. Congress has specifically limited the release of Restricted Data and Formerly Restricted Data (certain atomic and nuclear information). The munitions control laws limit releases of certain information, classified and unclassified, to certain foreign countries.
- **Foreign releases.** No classified information may be released to *any* foreign national unless there is specific authority covering the release. The National Disclosure Policy covering foreign releases provides standards, procedures and authorities for release of certain classified information to certain foreign countries and nationals.
- **Especially sensitive information.** Certain categories of information of a highly sensitive nature are subject to restrictions on release to identified recipients. In other words, the gen-

C. Donald Garrett is Deputy Director for Classification Management in the Directorate for Security Policy, Office of the Assistant Secretary of Defense (Administration). He has served in the directorate since 1958 and previously was Executive Secretary of the Security Screening Board and Security Review Board, Office of the Secretary of the Army. He holds a bachelor degree from Franklin and Marshall College and an L.L.B. degree from George Washington University.

eral need-to-know limits are defined, *e.g.*, cryptographic information, certain intelligence, and other special access categories of information. In some of these areas, the need-to-know restrictions are established by agencies outside DOD.

Subsection VII.D., DOD Directive 5200.1, continues:

> These principles are equally applicable if the prospective recipient is an organizational entity, including commands, other Federal agencies, defense contractors, and foreign governments.

In many cases the need-to-know determination is based upon the needs of an organization. In these cases, the person who will actually receive the classified information may not be known or ascertainable to the holder, the releaser. The original releaser's need-to-know responsibilities would be satisfied when he establishes the organization's need for the information. It is necessary to assume that the internal structure and procedures of the receiving organization will ensure release to the individuals in the organization who have the requisite need-to-know.

What Are "Official Duties?"

The need-to-know concept is related directly to the interests of national defense by Executive Order 10501. As in the case of deciding how to define "the interests of national defense" for security classification purposes, for need-to-know purposes the term is construed on a very broad base to include practically any governmental activity that affects or relates to:

- The capability of the United States to defend itself.
- Any national defense advantage (strategic, tactical, technological, scientific, logistical, and even economic or political as it might affect U.S. domestic or international relationships) the United States has over other nations.
- The international posture of the United States and our relations with foreign nations.

In one way or another, practically every agency in the Executive Branch particpates at some time in activities affecting or relating to national defense. Members of Congress and Congressional committees, including their staffs, certainly become involved in national defense matters. The Federal judiciary considers cases in which national defense interests are involved.

It is fair to say, therefore, that any employee or official of the Federal Government, at one time or another, may become involved in activities affecting or relating to the interests of national defense. The mere fact of official connection with the Government, however, does not establish a need-to-know for access to classified information. It is necessary that one's connection with the Government place him in such a position that, in order to carry out his responsibilities to his employer (the Government), he must have access to certain classified information.

In many instances the level of an individual's connection with the Government makes it necessary for him to have rather broad access so as to enable him to keep abreast of developments, activities, or operations in which his governmental organization is involved. This kind of need must not be confused with a "nice-to-know" or a "nice-to-see" desire.

Here again, the mere fact of a high-level connection with a government office provides no basis for having access to classified information. There must be some reasonable connection between:

- The functions, purposes, or activities of the government organization involved.
- The individual's duties in that organization.
- The classified information or, at the least, the individual must be involved officially in some government activity relating to national defense, that makes access to the classified information essential to participation in that activity.

At the lower levels in government organizations, the need-to-know becomes more closely and necessarily connected with the duties each individual has and must perform in order to carry on the government business. In many cases the need is relegated to a mere "need-to-have" or a "need-to-handle," without need-to-know the substance of the classified information, *e.g.*, mail or equipment handlers and processors. It is always necessary to consider protection of classified information so that the substance of the classified information is not available to everyone who must handle classified material. Sometimes the nature of the material is such that anyone who handles it will have access to the classified information contained in the material. This becomes important when the nature of the classified information is such that the material must be wrapped or packaged, so as to preclude access by mere handlers who have no need-to-know the substance of the classified information.

In some few cases, the party who desires the information may be in a position in which it is difficult to see a need-to-know. The circumstances may be such as to render it imprudent or even unproductive to inquire further into the reasons why access is desired. In such cases, either the holder recognizes that the party concerned has governmental connections or duties to which the classified information is reasonably, even though remotely, connected, or he decides to refer the matter to some higher echelon for resolution.

Private Enterprise

When the prospective recipient is outside the Federal Government, there must be a close relationship between the classified information and the duties, functions, activities, or operations of the recipient. Basically, access must be related to accomplishment of a government purpose related to national defense.

For contractors, who are performing or have been asked to perform under a DOD contract, the need-to-know is established by the subject matter of the contract. When a contractor is working under a contract with one government agency, there may be a reasonable need-to-know for classified information belonging to another activity within *that* Government agency. In this sense, the entire Defense Department is one government agency, and the needs of national defense demand a free flow of information between all elements of the department and the contractors thereof. There should be a minimum of question on need-to-know when it is shown or known that there is a direct or reasonable connection between the classified information and the subject matter of a contract, or the activities or functions of the contractor in relation to government business.

In many fields of interest, a general need-to-know exists among all or many participants in that field of interest. To facilitate military developments, to conserve resources, to make

maximum use of available expertise, to eliminate wasteful duplication and to reduce costs, it becomes important to ensure a free flow of scientific and technical information among the community involved in a particular field of interest. Any contractor working on a government contract in that field of interest may well have a reasonable need for all available information to assist in performance under the contract.

Private facilities which do not have current contracts should be considered to have a legitimate need-to-know for classified information. The information is needed to maintain their capabilities as developers and producers of future equipments or advanced generations of existing equipments. Further, classified information may be needed to enable them to contribute their expertise in the search for new and better military equipment. In all these cases, however, the nature of the contribution the private facilities can make to national defense must be more than theoretical, it must be actual and demonstrable, although not necessarily immediate.

Who Has a Need-to-Know?

Within a DOD activity the commander or top supervisor is responsible for ensuring application of established need-to-know principles. As a practical matter, unless there is a particular reason for very tight need-to-know controls, once an organizational entity or anyone within an organization is determined to have a legitimate need-to-know, all of the principals and most of the hired hands in the organization would be considered to have requisite need-to know. An organizational head must be free to select those of his people who are to work on a particular subject at a particular time. For necessary flexibility, therefore, more than one person in the organization will need to have access to classified information that comes into the organization. In the sense used here, the "organization" should be the smallest unit involved in a particular line of work, such as a section or branch. Need-to-know in echelons above that organization should limit need-to-know to only those persons who supervise the organization, or engage in the same line of work with the organization.

The foregoing does not mean that *all* persons in an organizational entity are entitled to have access to *all* classified information that comes into the organization. Even in small organizations, only those person who need the information to carry out their official duties should have access to it. This would include, of course, as a general rule, the chief of the organization, one or more of his professional staff, and one or more of the clerical help.

A person may have more than one personal status, *vis-a-vis* classified information. For example, he may be a DOD or a DOD contractor employee, and also a military reservist. He also is a private citizen. As an employee, he may have need-to-know to certain information to which he would have no need-to-know as a military reservist and, certainly, no need-to-know as a private citizen. When he has a need-to-know and obtains access to certain classified information, he is, of course, privy to the information as an individual. His use of the information, however, is restricted to his capacity in the status in which he received it. He is privileged to pass the information on to properly cleared persons who have a need-to-know in relation primarily to the status in which he received it. He could, of course, pass it on to *proper* parties in relation to his other official government status but, as a private citizen, he is *not* privileged to use the classified information for his own benefit or to pass it on to anyone.

The "government purpose," for which access to classified information is claimed to be necessary, should be related in some way to the interests of national defense. The needs of the Government are so broad, however, that this connection often may be somewhat remote. It is axiomatic that the strength of the U.S. Government and the nation in all fields is related to its strength in the international arena; therefore, all activities affecting the strength of the Government and the nation affect the interests of national defense. For example, it would be appropriate to release classified information or equipment to a non-defense government department for the purpose of determining the usefulness of a piece of classified equipment for meeting the needs of the requesting department. It would also be appropriate to authorize release of classified information in a court case in which DOD or the Government is not a party, but only if it is first established that the interests of national defense would thereby be served.

In summary, "need-to-know" is a vital concept, and strict application of it to *every* release of classified information is absolutely essential. Arbitrary actions and parochial views, which result in denials of classified information to parties who have established a reasonable need, are wasteful and dangerous. It all cases, a reasonable approach, leaning to approval in doubtful cases, is necessary to facilitate the Governments business and the general national interest in maintaining a viable, progressive national defense posture.

Research Sub To Conduct Gulf Stream Study

The world's largest non-military research submersible, Ben Franklin, will begin a month-long experimental cruise early in 1969 travelling along the Gulf Stream, from the tip of Florida to a point off the Massachusetts coast.

Equipped and supported by the U.S. Naval Oceanographic Office, scientists will monitor the craft's sensor systems during the undersea voyage.

The experiment also calls for photographing of the sea floor and its environment by a complex system of camera, sonar and closed circuit television equipment as the submersible is propelled northward by the current.

Included on the craft will be sensing devices designed to measure temperature, salinity, depth and pressure of water, irregularities in magnetic field, light absorption of water, and the turbulence where two opposing currents meet.

The Ben Franklin is owned and operated by the Grumman Aircraft Engineering Corp. but most of its equipment was provided by the Naval Oceanographic Office.

Although the deep diving vehicle i equipped with four 25-horsepower A(electric motors, the submersible wa designed to be propelled northwar along the Gulf Stream by the curren itself providing a noiseless enviro ment for research and observation.

Army Moves to "Design for Support" Attitude

Ralph F. Thompson

The Army has moved from a solely "support the design" posture to include a "design for support" attitude in approaching the problem of establishing viable integrated logistic support (ILS). Under the new concept, functional activities and operational elements are coordinated under a four-pronged, disciplined management system. This total management system comprises a planning system, a series of procedural models, a data system, and a contract specification manual.

Progress toward this altered approach has been slow but consistent. The Army had considerable experience in the application of ILS principles even before DOD Directive 4100.35, "Development of Integrated Logistic Support for Systems and Equipments," was issued. A trial implementation on the M561 Truck (Gama Goat) of the Early Support Implementation Plan, prepared by the National Security Industrial Association (NSIA), contributed extensively to our background of practical experience. As a direct result of this experience on the Gama Goat, we very early became convinced that an adequate specification was required to establish necessary communication between the Army and the contractor. Much effort has been directed toward development of this specification. Also as a result of experience with the Gama Goat, we learned that the ILS "logistician" should participate in the "sign off" approving engineering changes to the system.

Rather than undertake a sequential description of progress, this article will discuss the Army's approach to integrated logistic support within each of the following areas:

- Organization.
- Personnel.
- Policies and procedures.
- Support Management.
- Specifications.
- Maintenance documentation and analysis.
- Test and demonstration.

Organization

The Army has followed the evolutionary approach to its organization for the planning of ILS. In the Department of the Army staff, the obvious element responsible for ILS is the Deputy Chief of Staff for Logistics (DCSLOG). Accordingly, Army policies and responsibilities for ILS are established by DCSLOG. Responsibilities for management are assigned by Army Regulation 750-6, "Maintenance Support Planning," to each of the major Army field commands. These commands include, primarily, the U.S. Army Materiel Command, The Surgeon General, the U.S. Army Strategic Communications Command, and the U.S. Army Security Agency. Using the Army Materiel Command (AMC) as typical, Figure 1 shows the command organization. The ILS support planning function is assigned to the AMC Director of Maintenance and, in turn, to the Support Division within the Directorate. Other organizational elements shown on the chart also participate in ILS activities.

While this organization appears to be satisfactory, there can be little doubt, from current experience, that improvements in staffing and procedures are needed. Here, again, the evolutionary approach will be used to orient methods and procedures to achieve the long-range objectives of ILS. The Army has always recognized that design decisions may have a major affect on logistic requirements. To obtain simultaneous consideration of both support requirements and design decisions, the Army expects to establish concepts and characteristics

Ralph F. Thompson is Chief of Systems Effectiveness Branch, Maintenance Engineering Office, Army Materiel Command. He was a member of the DOD Working Group which prepared the DOD Systems and Equipment ILS Planning Guide, and he is Chairman of the Steering Committee for Development of Army Integrated Materiel Support. He is a graduate engineer.

which, when sufficiently defined, will exert a design influence favorable to the logistic requirements. Furthermore, we are progressively achieving better recognition of the relationships of each functional organization responsible for an element or aspect of logistic support. As these relationships become better defined, a better balance between them can be achieved.

Finally, this same organization extends downward to the national maintenance points at AMC commodity commands. These national maintenance points provide top level management of ILS planning for materiel within their command, and are identified as the logisticians who perform in accordance with the requirements of DOD Directive 4100.35.

Personnel

Like any other activity, ILS depends upon people to achieve its objectives. The selection, assignment, training or orientation, and the motivation of the logisticians throughout the Army structure will continue to require serious consideration in the future.

Fortunately, the Army has a training course already in being. The Maintainability Engineering Intern Training Program at the Logistics Intern Training Center, Red River Army Depot, Texarkana, Tex., was established to train graduate engineers in maintainability. These engineers are well qualified to assist in establishing logistic requirements to influence design in favor of maintainability and reliability. Recent study also indicates that this maintainability training program can be condensed and used to provide ILS training at the undergraduate level to the logisticians at our national maintenance points. We expect to combine our limited number of maintainability engineers with the larger number of other (technical) logisticians to obtain effective ILS planning teams.

Having recognized the engineering and technical skills required, let us see what further knowledge is expected of the Army logistician in ILS. He has responsibility for administrative duties such as planning and management of the ILS effort. He is responsible for the support planning for a weapon system. He must understand and be able to contribute significantly to the weapon system program *during each of its life-cycle phases*, beginning with the concept phase and continuing through contract definition and development. To be effective, he must also understand the procedures and problems characteristic of support in the operational phase. These realities of operations are not readily learned from the textbook or in the office. In addition, he needs an intimate knowledge of the missions and functions of each of the separate logistic element managers within his organization.

The Army has recognized the need to acquire these experienced people with the necessary administrative and technical skills. To meet this need, training courses in maintenance management, logistic management, and project management are being expanded and updated.

Policy and Procedures

ILS policies and procedures are contained in a variety of Army regulations and implementing directives under the umbrella of Army Regulation 750-6. This regulation has recently been changed as a result of logistic studies directed toward improvement of the Army support planning system.

Each major Army field command, such as the Army Materiel Command, has adapted Army Regulation 750-6 for its own use. In addition, a proposed management system is being prepared for publication in a series of Department of the Army technical manuals, which will provide guidance to the logistician with respect to both procedures and techniques for implementing ILS. The purpose and scope of these manuals are broad. Included are a management manual, a support

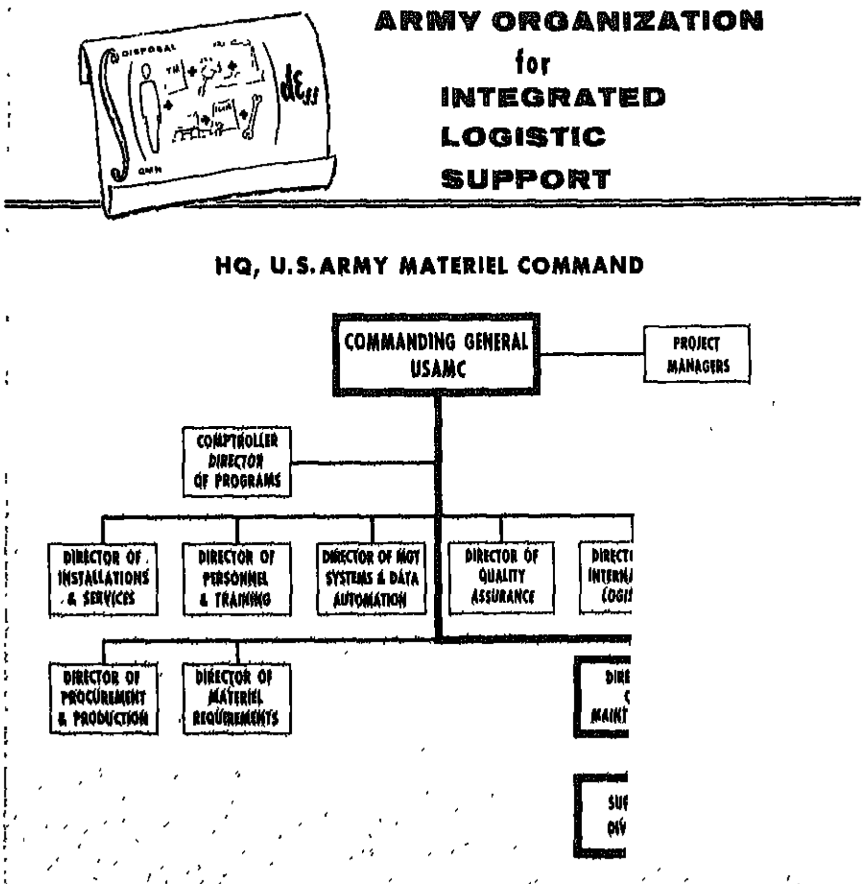


Figure 1.

integration manual, a procedural guide, a maintenance engineering analysis data manual, and a contractual procedures manual. These manuals provide guidance for the development, acquisition, and use of total support for a system throughout its life cycle.

Support Management

Support management of ILS in the Army is performed through the ILS plan, including its elements. This document is a principal supporting plan to the project manager's master plan. In turn, the elements forming the composite ILS plan serve to integrate, coordinate and schedule progress among the various logistic management elements such as funding, acquisition, planning, distribution, training, data accumulation, and transportation.

Specifications

As mentioned earlier, the Army studied various approaches to contractual specification for ILS. Review and comments from industry were solicited in two earlier approaches. Although it is not feasible to attempt a specification which could be used without modification on all systems in all commodity areas, it is expected that the proposed Army specification will enable satisfactory communication with the contractor beginning with the request for proposal (RFP). Essentially, this specification calls for the contractor to submit his recommended program for implementing ILS with certain Army input and controls.

As the Army specification moves into its first series of contract applications, its impact will be evaluated and necessary revisions will be made. We estimate that it will be at least two, possibly three, years before the specification package will be completed and proven by contract negotiations.

ILS must be the product of a systems approach to support planning. There are no other choices of approach when one considers the interdependencies that exist between elements of the support system. It is not difficult to visualize the impact that total absence of repair parts, equipment publications, support equipment, or skilled personnel would have on materiel readiness in the field. It is, however, less obvious, but nonetheless true, that actions and decisions related to *development* of these elements are mutually supporting and interdependent.

Inherent in the systems approach is the requirement for complete, accurate and timely data. The cost of collecting, analyzing and retrieving data, and the volume of space required to store this data are recognized as major problems associated with the development and acquisition of modern materiel and support systems.

Maintenance Documentation and Analysis

As an answer to these problems, the Army is establishing a Maintenance Engineering Analysis Data System (MEADS) (Figure 2). This system will be automated when and to the degree feasible to obtain optimal integration of maintenance engineering and analysis data.

Data required for life-cycle costing; budget purposes; evaluation of support alternatives; reliability and maintainability apportionment and assessment; task, skill and manpower analysis; initial provisioning; equipment publications; or many other support-related purposes must be obtained during the development and production phases in progressing degrees of detail. Data to satisfy these support planning requirements are interrelated and interdependent, and any attempt to collect, store and analyze them separately and independently results in unnecessary delays and costs. For example, life-cycle costing data, while intended primarily for procurement purposes, constitute a valuable input to the evaluation of maintenance support alternatives. Similarly, initial provisioning data and source data for equipment publications are both traceable to data derived from the task, skill and manpower analyses.

The MEAD System is initiated early in the development life of new weapon systems and equipment and extends through production and early operation. It will be capable of accepting data on fielded equipment from The Army Equipment Records System (TAERS) for comparison with developmental data and for maintenance engineering analysis purposes. As development progresses, continuing maintenance analysis of the design drawings, and/or proto-

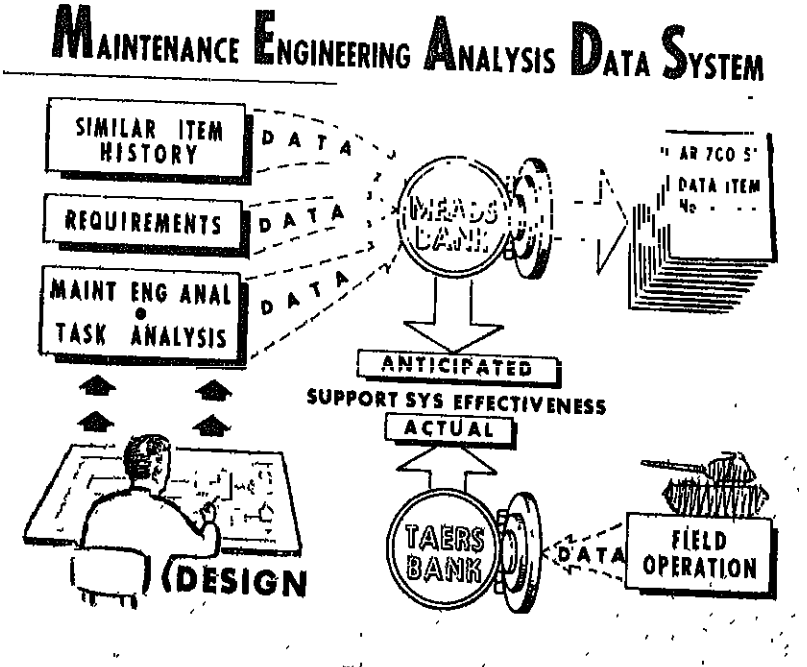


Figure 2.

type hardware or mock-ups, provides progressively more detailed data. The documentation is provided for each subsystem and maintainable component or assembly. The breakdown of data as it relates to functional components, *i.e.*, engine, hydraulic system, armament system, etc., permits analysis and evaluation of each of these systems individually as well as in relation to total weapon system performance.

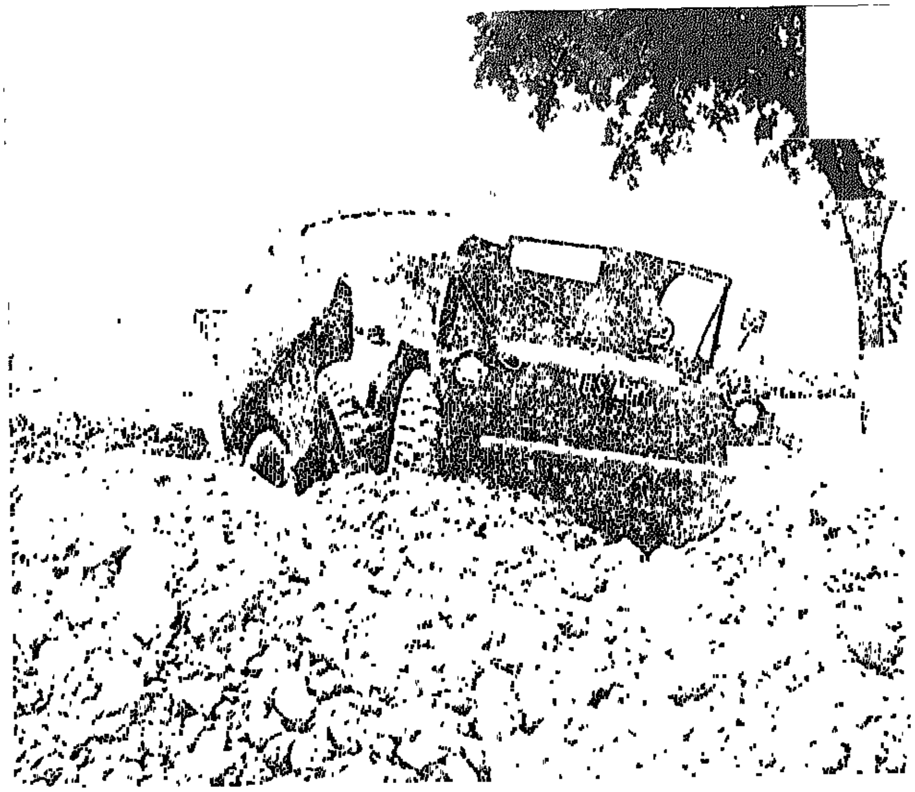
The framework for documenting MEADS data consists of 10 worksheets. The first four are input sheets and consist of:

- An item maintenance summary sheet completed for the end item or materiel system, and for each level of the system breakdown for which maintenance requirements have been established.
- An item maintenance support plan completed for each repairable item on the system.
- A maintenance analysis summary, also completed for each repairable item in the system.
- A maintenance task analysis sheet which is completed for each maintenance task associated with each repairable item.

The remaining worksheets summarize the information for analysis purposes, and are derived from the data on the four input sheets. These sheets provide summaries of support equipment, training aids and devices, spares and repair parts, personnel and training, technical data and information, and special facilities.

The MEAD System is an important key to the attainment of effective integrated support planning. It lends itself to the systems approach for support development by keeping the interrelationship of the support elements and the end item visible through a central data system. Such a system should provide a cost advantage over piecemeal acquisition of support related data.

Another facet of the systems engineering approach involves the need to effect meaningful design and logistic tradeoff actions. The systems approach inherent in ILS offers the opportunity for the designer and the ILS logistician to work together in seeking that approach to total system design which will result in optimum performance. It is through the injection of logistic consideration into design tradeoffs that this alliance has its most beneficial impact.



GAMMA GOAT vehicle crosses difficult terrain. Army's integrated logistic support plan was first used on this vehicle.

Perhaps the physical teardown, allocation and evaluation review is a unique facet of ILS in the Army. It is normally not combined with other formal Army reviews. The purpose of this nondestructive review is to accomplish a maintenance analysis and evaluation of the end item from a maintainability standpoint, to prepare and offer meaningful recommendations for design changes, and to evaluate the effectiveness of the necessary maintenance tools. This review is sponsored by AMC in coordination with the Army Combat Developments Command and the Continental Army Command. When incorporated in the contract, it becomes similar to a contractor demonstration of the system hardware and data. A coordinated maintenance allocation chart resulting from this review provides firm direction for further development of the maintenance test package, required to accompany the end item hardware provided for engineering tests and, subsequently, for service tests.

Test and Demonstration

The Army considers that its series of acceptance tests, performed by an independent test agency, provide for satisfactory test and demonstration of the logistic support package. While the maintenance evaluation portion of these tests still requires improvement to test an entire package, increasing emphasis will be placed on this aspect in the future. Improved methods for stating, testing and demonstrating achievements against incentive clauses are also being developed.

The Army believes that ILS is applicable to almost all systems and equipment acquisitions. ILS in the Army is being formulated for the most complex systems, with provision for tailoring requirements to less complex equipment. We have come a long way in the last four years. As we become progressively more involved in Army-industry communications regarding ILS, we hope and expect to acquire even better methods for implementing it.

Defense Contracting— The Problem of Distribution of Risk

Speech by Lt. Gen. Charles H. Terhune Jr., USAF, Vice Commander, Air Force Systems Command, at the 1968 Western Briefing Conference on Government Contracts, San Francisco, Calif.

It is a great pleasure to be here today and to have the opportunity to talk to you and participate with you in a discussion of "contracting" and "distribution of risk," a subject in which I am sure you are all very interested. In fact, this discussion, I am sure (before it is over) will resemble the description of the elephant by the five blind men—and I believe most of it will be based on honest differences of opinion or motivations.

I am not a lawyer. I cannot share your most professional discussions, but I am vitally interested in the successful development of weapon systems for the Air Force at maximum performance on a specific schedule—for a specific price. I am sure all of you want the same things for the country; but, you have one or more added incentives: a reasonable profit and a good reputation to name two that enter my mind without much prompting. So, while we have the same objectives, we diverge a little on some of our motivations, and accommodating these differences really highlights the basic problem we face in defining mutually acceptable contracts and risks.

Development Risks

I conclude, after looking at the risks of development [illegible]nning, man- [illegible] ct defini- [illegible] responsibility, and total package procurement, that the fundamental risk for both industry and the Government is technical risk associated with financial or cost risk. For the contractor, the concern is that the job will be more difficult than anticipated, probably in unexpected areas and, therefore, the cost will be higher and the profit lower—or that there may even be a loss. For the Government, the fear is that the performance will be short, the schedule too long, or the cost will be overrun unacceptably. Alignment of interests in some fashion is imperative to at least minimize differences in motivation between customer and supplier.

I can recall only one risk-proof situation. St. Peter became exasperated with the devil, one day, over some cost figures and threatened to sue. The devil merely laughed at St. Peter's threat—he was not exposed to risk—he knew there were no lawyers in heaven.

In a recent discussion of our procurement processes, the subject of the first aviation contract ever awarded was mentioned—that with the Wright Brothers. It may interest you to know that document involved most of the basic risks which we discuss daily. Specification No. 486, dated Oct. 23, 1907, requisitioned a totally new weapon system described as a "Flying Machine." It required bidders to submit, with their proposals:

> **Drawings to scale, Statement of Speed for which it is designed, Statement of Total Surface Area of the Supporting Planes, Statement of Total Weight, Description of the Engine which will be used for motive power, and the Material of which the Frame, Plane, and Propellers will be constructed.**

It even recognized the risk of data disclosure in a provision that stated, "Plans received will not be shown to other bidders." I should mention the incentive risk provisions of this historic $24,000 contract. I quote:

Lt. Gen. Charles H. Terhune, USAF

> **The flying machine should be designed to have a speed of at least 40 miles per hour in still air, but bidders must submit quotations in their proposals for cost depending upon the speed attained during the trial flight, according to the following scale.**

Forty miles per hour was rated 100 percent of target price; 39 miles per hour, 90 percent; 38 miles per hour, 80 percent; etc., down to 36 miles per hour below which the plane would be rejected. Similarly, on the upward scale, 41 miles per hour was 110 percent; 42 miles per hour, 120 percent; on up to 44 miles per hour at 140 percent of target price. This contract still represents an accepted method for asking the industrial community to share the performance risk of its products.

Since the days of the flying machine contract, many methods and procedures for acquiring systems have evolved. From time to time, performance, schedule, or cost have had varying degrees of emphasis. The risk has been shared or shifted between the Government and industry, *i.e.*, from cost plus a percentage of cost to fixed price. However our primary goal has always been to obtain the best technical performance possible.

To achieve our goal of technical excellence, we have attempted to engage all resources available both within Government and industry. We try to strike a balance on what we want versus what we can get with reasonable risk—"risk" in the sense that we must have an effective product for na-

tional defense—(we cannot always wait for the ultimate product). Also, we do feel a sense of responsibility on how much risk we ask a contractor to assume.

The contractor, too, is interested in being associated with a new product. He would like it to be an exciting new product which would enhance his reputation, but not at the expense of profit. So again each participant for his own reasons, whatever they may be, wants to reduce his risk. It is for these reasons that management and procurement techniques have been developed to aid us in achieving our goal or reducing the risk in acquiring operational systems.

Development Planning

The emphasis which we have placed on development planning is relevant to the reduction of technical risk. This process has been termed "concept formulation." The objective of concept formulation is to provide a technical, economic and military basis for advocacy of new systems, or supporting equipment for improvement of Air Force operational capabilities. Activities included are technology application studies; proposals for advanced development—why demonstration should be done now and not at some later date; and proposals for new systems, subsystems, or major modifications. Included in the last category are preliminary design or tradeoff analyses to establish what is feasible. Emphasis is placed on how contract definition will be conducted, and how the management approach and contract types are selected.

With the advanced engineering and science required today to design and produce a weapon system, we believe the emphasis which we place on development planning has reduced the Government's and industry's risk. We recognize the value of informing industry of our plans for the future and hope industry, too, will perform more and better development planning, and include potential subcontractors in this "look-ahead."

We Allocate Risk by Our Management Approach

The selection of the program's management structure and type of contract is a key decision in distributing the risk for design and performance. As you know we use two primary management structures in acquiring weapon and support systems. One is the prime subcontractor relationship, where the prime contractor selects the subcontractors, performs the systems engineering, and issues the technical direction to the subcontractors. The Government here has a systems engineering role, but it is limited principally to its relationship with the prime.

The second management arrangement is the associate contractor structure. This method was developed for the *initial* ballistic missile program. Here the Air Force selects the associate contractors, and the Air Force (or another contractor) performs the role of system engineer and issues the technical direction.

Recently, we completed a comprehensive study concerned with the management alternatives available to the Air Force. It came as no surprise that the industrial representatives interviewed prefer the prime subcontractor relationship. One of the reasons given was: "The industrial organization exercising systems engineering on subs has a counter balance of a prime contract with the Government. In contrast, a 'third party' systems engineering contractor has little or no counter balance to compromise his insistence on technical excellence." I quote this because it alerted me that we must thoroughly understand all motivations, and must be watchful of the decision environment which we create in the system acquisition process.

The sheer complexity of some of our development programs demands a technical conscience (representing the Government), *i.e.*, an intensive and detailed participation by either the Government or an objective "third party." The Minuteman program illustrates this point. This program is large with a multitude of configurations. The threat (or at least our understanding of the threat) constantly changes. The state of the art continues to advance—sometimes dramatically. In response to the threat or the technology opportunities, we develop new components or subsystems and modify a fleet already in the field. Under these circumstances, it is not surprising that we, the Government, retain some of the responsibility for design and performance in order to take advantage of unforeseen opportunities, or to avoid undesirable decisions based on contractual incentives which are outmoded by events.

An often expressed opinion is that systems engineering and technical direction clauses are basically incompatible with incentive contracts, incompatible particularly with fixed price incentive contracts, which establish the relative values of alternatives from which the contractor has the freedom to choose in making tradeoff decisions. We have found that the use of contract incentives does not assure that the hardware producing contractor will share the same objectives as the Air Force. Neither party can foresee all the technical difficulties, technical advances, or changes to the operational requirements which may occur in the course of a multiyear program. The Government must participate to maintain a balance in schedule, cost and performance. The Air Force program manager must be held responsible for assuring that the best tradeoff decisions are made within the incentive matrix.

Our recent study of management alternatives confirmed that industry also does not believe that the Air Force can employ a "hands-off" policy and expect to achieve the best operational system. Industry expects the Air Force to isolate technical deficiencies, to make tradeoff studies and, where necessary, to issue technical direction to correct the deficiencies or exploit the more attractive alternatives than may be open. Thus our selection of a management approach and procedures both influences, and is influenced by the technical risk involved.

Contract Definition

Practically all of our major systems must undergo contract definition before proceeding into development and production. The basic objective of contract definition is to establish sound and achievable performance specifications; precisely define interfaces among the various elements of the total system; and develop creditable schedules and costs suitable for firm, fixed-price contracting, or a fully structured incentive contract.

The process of contract definition tends to bring the competitive proposals closer and closer together by the very nature of the procedures involved in each step of the process. Considerable effort is expended in the evaluation process to examine the soundness and logic of the preliminary design submitted by each com-

petitor to satisfy the requirement. Wind tunnel tests are reviewed; computer runs are carefully examined; and all proposed subsystems are given detailed and careful scrutiny against established Government standards. These evaluation techniques are quite useful in providing an insight as to how well the contractor understands the system problem; the degree to which he has exercised ingenuity and resourcefulness in bringing to bear the proper technology for the solution of the problem; and finally, provide the basis for an assessment of the level of confidence that should be placed in the contractor's promise that he can meet the requirements established for the system in a timely and effective manner.

The dilemma is that we do not contract for the detailed design of the system—and I don't want to imply we should; however, this means that the contractor has no obligation under his contractual commitment to proceed with the basic design concepts which he submitted. In fact, he is free to depart from his ideas, if necessary, to achieve the performance specifications of his contract, or (in his own interest) to seek a better balance in his incentive areas because part of his job turned out to be more difficult or different than anticipated. What this all means is that the superior design approach is non-contractual and not automatically achieved.

On the other hand, we also recognize certain problems and risks for the contractor. Some of these problems are:

- Technical and performance requirements continue to change.
- We may not go far enough in our evaluations to fully understand the technical risks ahead.
- Delayed decisions undoubtedly cause severe management and funding problems for the contractors.
- Subcontractors benefit little from the direct contract definition funding provided to the prime contractors.

Total Package Experience

ition is de-

the other, but let me assure you this is a two-way street, and it is not clear to me who has the biggest club. In any event, we do not have the objective in our contracting of putting people out of business. We must feel a sense of responsibility in identifying the risk we ask the contractor to assume. Sometimes this is particularly difficult, since we quite often negotiate the contractor's proposals into the contract—not ours. In fact, I sometimes get the impression we are getting blamed for letting the contractor sign a contract which contains the performance he proposed.

As you know, total package procurement contracting envisions that development, production and support requirements for a system be procured under one contract. Price and performance commitments are obtained during the contract definition phase. To date, all total package contracts have been fixed-price incentive.

Our major objectives in total package procurement are to:

- Inhibit "buy-in."
- Permit the Government to use competition more effectively.
- Encourage industry to design for economic production.
- Motivate the contractor to obtain supplies and services from the most efficient source, whether in-house or by subcontract.
- Obtain long-term commitments leading to program stability and continuity.
- Enforce design discipline.
- Encourage efficiency.
- Better control changes.
- Motivate the contractor to control cost.
- Foster program discipline on the part of both the contractor and the Government.

Experience with the TPPC approach has not yet carried through one complete cycle. Results to date illustrate that forces other than engineering and production affect the project either before or after the contract is signed—both in the Government and in the company. The results, as I see them—and I know I see them differently than industry, although I feel I know their objectives, too—have carried us toward the goal of enjoying the benefits of competition, but may have created other problems along the way.

A Need For Adjustment

So, where does this leave us today?

What we need and must mutually work to achieve, in my opinion, is better balance between the financial risk and the risk of the technical unknowns.

Improvements in the contract definition process can help further reduce the technical uncertainties.

Perhaps, as some people contend, contract definition does not go far enough. Perhaps contract definition should include some development and fabrication (or prototype) hardware for test. Under these circumstances, both the contractors and the Government could have more credible information on which to base decisions—resulting in fewer risks to both. However, we must think this option through carefully. The longer a final decision is delayed, the more fierce the competition becomes. Delay increases the risk to the competing sources. The loser will have tied up considerable resources for a longer period of time with limited pay-off. We also must determine if the nation has the technical resources to afford this redundancy.

I believe that less dramatic ways exist for reducing technical risk through more emphasis on independent research and development, advanced development, and component improvement programs. Such emphasis would create a better base on which to build our system performance objectives. I believe we err in waiting for a specific operational requirement before starting most advanced developments.

Although I have mentioned some problems associated with the concept of total package procurement, on balance I believe it has been an improvement and is valid. As applied to the C-5, it is still appropriate for future use. However, we believe that some changes are required to adapt it to the procurement of weapon and support systems.

A recent Air Force Systems Command study on total package procurement concluded that even where the development did not introduce unacceptable technical risk for any single element, the integration of a large system could involve sufficient risk to make the application of total package inappropriate. This finding is primarily predicated on the misgiving that undue emphasis on cost and economic

(Continued inside back cover)

DOD Completes Plans for FY 1969 Expenditure Reductions

The Defense Department has completed plans under Project 693 to reduce FY 1969 expenditures by $3 billion from budget estimates submitted January 1968.

The Revenue and Expenditures Control Act of 1968 requires a total expenditure reduction of $6 billion for the Federal Government. The Defense Department share of this reduction is $3 billion.

Announcing the completion of Project 693 on December 10, then-Secretary of Defense Clark M. Clifford said a thorough review with the Military Departments and Defense Agencies was initiated in early June 1968 to identify areas in which FY 1969 expenditures could be reduced, under three principal guidelines:

- The needs of our forces in Southeast Asia were to be provided for fully, without exceptions.
- The necessary reductions were to be accomplished in such a manner as to minimize their adverse effects on our overall military strength.
- The programs and activities selected for reduction were to be arrived at cooperatively by the Services and the OSD staff, and all proposed changes involving forces and major weapon systems were to be reviewed by the Joint Chiefs of Staff. When agreement could not be reached through this procedure, the issue was to be resolved by the Secretary and Deputy Secretary of Defense.

Final determinations on all actions necessary to meet the Department's expenditure reduction objective could not be made until Congress completed action on the Defense authorization and appropriations bills. However, a number of actions were taken early in order to obtain maximum advantage of the expenditure savings, and these were announced previously by the Department. These included:

- Not to complete activation of the 6th Infantry Division.
- Inactivation of 53 Navy ships and seven Naval Air Squadrons. (The original announcement of 50 ships and eight squadrons made Aug. 7 was subsequently revised to 53 ships and seven squadrons.)
- Inactivation of 23 Nike Hercules firing sites.
- Deactivation of seven F–101 squadrons in the first quarter of this fiscal year instead of later, as previously planned; and the stretch-out of F–111A and FB–111 production schedules.
- Early release from active duty of approximately 30,000 two-year Navy enlistees.
- Reduction of about 2,400 civilian positions in employment levels at Navy laboratories.

Amounts of the reductions made by the Services and the Defense Agencies to reach $3 billion in expenditure cuts for FY 1969 are shown in Figure 1. Also included are the program changes of $5.7 billion in total obligational authority which were required to obtain the FY 1969 $3 billion expenditure reductions.

While the reductions have been made in all areas of DOD operations, the greatest cuts in the case of Army are in the logistical support area for supplies, spares and repair parts levels and equipment maintenance for non-Southeast Asia forces; reductions in equipment procurements for non-Southeast Asia forces consistent with minimum impact on readiness; and reductions in military construction programs.

Major reductions in the Navy are in F–111B aircraft procurement; operational areas including ship and aircraft squadron inactivations, aircraft modification and rework, ship overhauls, administration and logistic support programs; equipment procurement for non-Southeast Asia forces; ship construction, military personnel and research and development programs.

In addition to unit inactivations and revised aircraft production schedules, the Air Force is reducing military and civilian manpower in support activities by 8,000 military and 8,000 civilian spaces; has deferred initiation of expanded proficiency pay awards in five specialist fields; slowed development efforts in the Manned Orbiting Laboratory program and slightly delayed its initial launch; deleted or delayed a number of construction projects; and reduced or delayed a variety of research, development, test and evaluation programs.

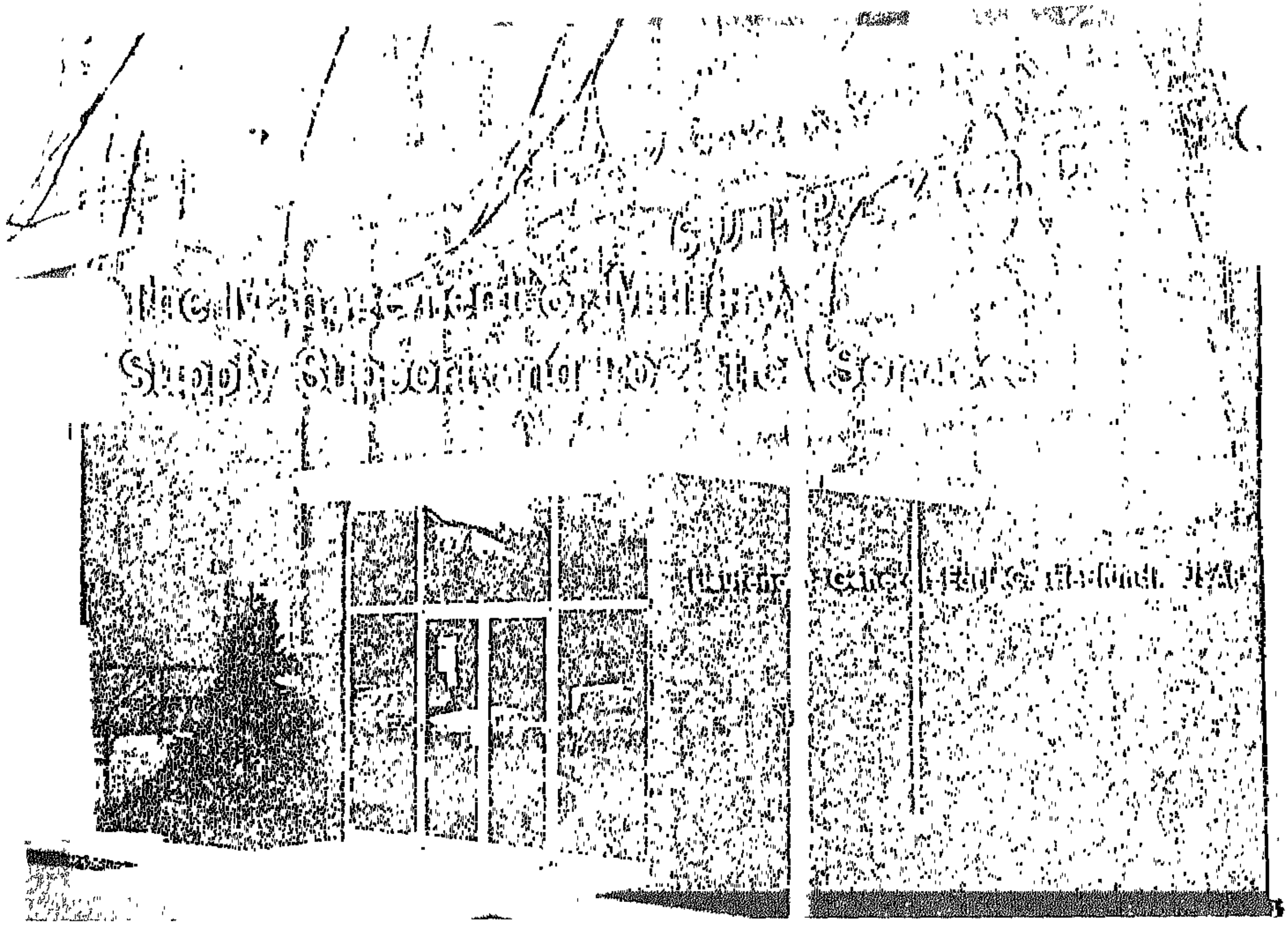
In OSD and the Defense Agencies, the major actions were reductions of not less than 3 percent in administrative areas, and reductions in the procurement programs for computer equipment and inventory levels in the Defense Stock Fund.

Defense Department Expenditure and Program Reductions

($ in millions)

	FY 1969 Expenditure Reductions	Total Program Reductions
Department of Army	$ 900.0	$1,443.3
Department of Navy	992.0	2,396.0
Department of Air Force	928.0	1,547.4
Defense Agencies	180.0	346.4
Total	$3,000.0	$5,733.1

Figure 1.



Editors Note: **This article on the Defense Supply Agency begins a series on the material and logistics commands of the Defense Department. Future articles will describe the Military Services' commands and subcommands, and subcommands of DSA.**

The Defense Supply Agency (DSA) is a military department store with annual sales exceeding $3.5 billion dollars.

The agency purchases and distributes supplies and provides logistic services common to all of the Military Services.

It is my intention here to outline the mission of the agency, its organization and functions, to describe the DSA management approach, and summarize our relationships with the Military Services' logistics systems.

The Defense Supply Agency was created by the Secretary of Defense in 1961 to increase efficiency of, and reduce the cost of managing common military supply items and logistics services, by eliminating overlapping and duplicating organizations, systems and procedures of the Military Services. Consolidating these responsibilities in DSA has one overall objective—effective and timely logistics support of operating forces at the lowest possible cost to the taxpayer. The mission is threefold:

- To provide wholesale supply support to the Defense Department and certain other specified government agencies.
- To provide consolidated field contract administration services to the entire Defense Department and the National Aeronautics and Space Administration.
- To provide certain DOD-wide logistics services and to administer or manage assigned logistics programs.

These responsibilities are carried out by a complex of DSA facilities located throughout the country. In addition to the DSA headquarters located in Alexandria, Va., there are six commodity-oriented supply centers, eight depots or depot activities, three activities providing logistics services, and eleven contract administration services regional organizations.

Staffing these activities are 1,100 military personnel from all the Military Services and over 57,000 civilian personnel, most of whom came to DSA from the three Military Departments.

Supplies procured by DSA range from fuel, food and clothing to industrial and construction equipment. The extent of its supply support operations is best illustrated by some basic statistics on DSA.

- DSA centrally manages some 1.9 million items of the 4 million items in the military part of the Federal Supply Catalog.
- Inventory at the end of FY 1968 was about $3 billion.
- Issues or sales to customers during FY 1968 totaled $3.8 billion.
- Procurements for the same period exceeded $5.3 billion, including $1.5 billion in bulk fuels and lubricants which were turned over directly to the Services and are not included in inventory or sales figures.
- Over 90 percent of the requisi-

tions received from customers were filled from available stock, and 82 percent of these within the time specified in the Uniform Materiel Movement Issue Priority System.

Requisitions from DSA's customers are processed at six Defense Supply Centers which procure the supplies. Five of these centers perform a full range of supply management functions. At these centers, supply demands are electronically processed against system-wide accountable records. Financial accounting, billing and collecting are likewise centralized. The sixth center, the Defense Fuel Supply Center, is primarily a purchasing activity, as inventories of bulk and solid fuels are not maintained by DSA.

Eleven depots comprise DSA's Distribution System. Seven of these are called Principal Depots because we stock in them a wide range of DSA materiel. Two of these are co-located with Defense Supply Centers at Columbus, Ohio, and Richmond, Va.; one is the Army Depot at Atlanta, Ga.; and the other four at Mechanicsburg, Pa.; Memphis, Tenn.; Ogden, Utah; and Tracy, Calif.

The remaining four are called Specialized Support Depots. Two of these are specialized by commodity and are co-located with the Defense Electronic Supply Center at Dayton, Ohio, and the Defense Personnel Support Center at Philadelphia. And, finally, two are specialized by mission and are located at the Navy Supply Centers, Oakland and Norfolk in support of Navy's fleet and overseas units.

We also have 10 direct supply support points which support large volume users of specific commodities, such as metal bars and shapes used by naval shipyards and clothing for recruit training centers.

The scope of logistical services provided by DSA cover not only the purchase, storage and issue of materiel, but includes contract administration services. This element of the DSA mission is concerned with the administration of contracts *in the field* after they have been awarded to contractors. DSA provides contract administration services to the Defense Department and the National Aeronautics and Space Administration (NASA). DSA contract administration services encompass:

- Security clearance of contractor plants and personnel.
- Administration of contracts after their award by procurement officers of the Services, DSA and NASA.
- Production and progress reporting.
- Inspection and acceptance of materiel and quality assurance.
- Accounting for government-owned property furnished to contractors.
- Payment to contractors for goods and services delivered.

DSA's Contract Administration Services organization, which carries out these functions, consists of 11 Defense Contract Administration Services Regions (DCASRs) throughout the United States and a central Industrial Security Clearance Office in Columbus, Ohio. (See article "DCAS Comes of Age" *Defense Industry Bulletin*, May 1968, page 1.)

At the end of FY 1968, DSA was administering some 258,000 prime and secondary contracts valued at over \$50 billion. During the year over \$20.6 billion worth of materiel was inspected and released for shipment, and some two million contractor invoices were paid.

In addition to supply and contract administration, the DSA mission includes providing a number of logistical services and administration of several DOD-wide programs. These services and programs are:

- The Federal Catalog program.
- Defense material utilization and disposal programs.
- Coordinated procurement program.
- Management of receipt, storage, retrieval and issue of defense research and technical documentation. (See article, "Program and Services of the Defense Documentation Center," *Defense Industry Bulletin*, April 1968, page 1.)
- Management of defense-owned industrial plant equipment.
- Design, development and maintenance of the military standard data systems procedures for requisitioning and issue, transaction reporting and accounting, materiel movement and transportation, supply system evaluation, and contract administration services.

Having described its mission and how DSA is structured to carry out these objectives, I would like to outline how the agency is managed.

Management Must Respond to Variety of Demands

The Director of the Defense Supply Agency reports directly to the Secretary of Defense. Certain guidance and direction come from the Assistant Secretaries of Defense (Installations and Logistics) and (Comptroller). Policy guidance on the defense technical documentation function comes from the Director of Defense Research and Engineering. The Assistant Secretary of Defense (Manpower and Reserve Affairs) gives guidance in civilian and military personnel matters.

All of these offices require reports on a variety of matters, including inventory range and depth, supply performance, changes to the Supply Catalog, and in what manner resources are allocated. For example, there are limits on the number of personnel who can be hired, the amount of dollars which can be spent, and the extent of authority or exercise of local judgments under certain circumstances.

This division of responsibilities is not greatly different from other government organizations. What distinguishes DSA is that the agency is

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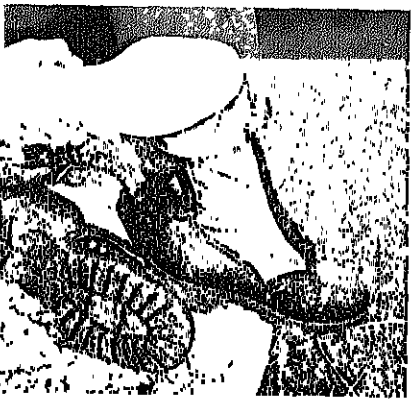
purely a service organization. DSA exists only to provide supply and service support to the armed forces. Consequently, in addition to the "bosses" already mentioned, DSA has many more—its customers. Our responsibility is to provide responsive, effective support to a wide variety of demands from a multitude of customers around the world. Thus, we have a number of "bosses" to satisfy.

Its customers place requirements on DSA as a result of the military operations they face. Frequently these requirements are not predictable. Consequently, DSA is not always able to respond as quickly and as positively as it would like. For example, DSA has recently been working out of a problem with repair parts for construction equipment, power generating machinery, and other equipment, which stems from not being informed of the need for these parts in time to procure them.

Solution of these problems and responses to changes in workload and program emphasis are management challenges of the first order. DSA managers must be skilled in many facets of military logistics, and flexible as well as responsive. They must be able to reorient and apply the work force in response to these changes.

Integrated Support Functions

A real management problem was posed to DSA early in its history—develop a single integrated system from the several systems inherited from the Military Services. Many customers were, and still are, oriented to project or program management, which is designed to insure maximum support of individual projects or weapon systems. Project management, however, is not desirable for controlling the 1.9 million items which DSA manages, many of which are common to more than one end item or weapon system. Nor is project management desirable for the wide variety of DSA logistics services.



TROPICAL COMBAT boots, one of the common use items bought by the DSA Defense Personnel Support Center.

Therefore, DSA needed other means of insuring that our basic support mission would work, and had to design procedures to evaluate the *performance effectiveness* of our common support functions. Support objectives were clarified and, through a cost effectiveness analysis of many alternative organizational, functional and operating procedures, the present system was developed. Present procedures provide across-the-board support for all the items required. This system might be called "process management." We control the effectiveness of our operating procedures by evaluating the total logistics support process—instead of evaluating the support given individual items, weapon systems, or projects.

Process management caused us to delve deeply into the various means of monitoring and evaluating management. DSA adopted a concept of strong, central policy guidance, direction and control, and maximum decentralization of operating authority. In order to make such a system work effectively, DSA top management devised means to exercise control and at all times be informed of how policies are carried out. Uniform organizational elements, staffing patterns and procedures were installed in the field activities. Reporting, data processing, and management information systems were standardized. These standardized systems permit DSA to divide the total logistics support mission into identifiable and manageable segments, to coordinate and summarize millions of individual transactions, and to automatically provide every level of DSA field and headquarters management with the precise data needed for effective and timely decision making. Simply stated, these standardized systems and procedures enable the man at the top to concentrate on management—to assure that thousands of things come out right at the other end. They make it possible to operate as a highly centralized organization.

Resource Management System

To complement and support this centralized procedural system, we have an executive communications, review and analysis system which communicates problem areas to the Director without delay as these manifest themselves.

By establishing specific goals or key indicators of performance for each supply process, DSA insures that top management is apprised, on a timely basis, of the status of all its operations. Consequently, top management can make rapid evaluation of each supply process. The system also provides the basis for formal management of resources and workload through the DSA programming and budgeting system. This system, which is similar to those used in the Military Departments and other government agencies, integrates programming, budgeting, manpower, accounting, and performance evaluation, and permits us to cost out the supply processes or functions, no matter where they are performed in the agency.

To insure maximum communication among the various levels of management, and to permit maximum management by exception, DSA uses a Resource Management System composed of a series of subsystems.

The first subsystem relates programming and budgeting. It is the means by which workload forecasts and resource requirements are set for each functional program area. Workloads developed through this system, when equated to resource requirements, become the basis for the annual financial plan and staffing programs established for each field activity. Performance appraisal compares actual program performance and resource consumption with annual forecasts and objectives to determine any need to reapportion or reallocate resources.

The subsystem for cost accounting is related to the DOD program budget system through common functional classification structure. Cost accounting provides manpower and cost-expense data reflecting the manner in which available personnel and dollar resources are applied and consumed.

The management information subsystem is the prime medium for reporting progress to the Director,

Through recurring management reports, it provides basic data on operating program results. This subsystem accumulates manpower, cost and performance data which are deposited in a mechanized central data bank. This data bank is the source of most of the management data used in our program performance evaluation.

Performance evaluation reports are one of the prime management tools used at DSA headquarters. This subsystem evaluates resource use in relation to operating results by comparing actual performance with statistical or engineered standards. It alerts us to changing conditions which may require reapportionment of available manpower and funds. It provides timely and factual information for continual "tracking" and appraising how efficiently and effectively available manpower and financial resources are being used to accomplish some 75 different logistics functions.

Command Objectives Program

Complementing the Resource Management System is another management system, the Command Objectives Program, which has substantially aided DSA management. The Command Objectives Program identifies those areas which warrant special management effort, reaching into virtually every corner of DSA activities.

The Command Objectives Program is, by concept and design, action oriented. Once an objective is established, primary actions required to attain that objective are listed and broken down into secondary actions, with specific dates set for accomplishment of each action.

These are called Headquarters "Do List Items." Every 90 days I personally review each "Do List Item" with the executive director concerned, along with responsible action officers assigned to accomplish or coordinate the action. During these reviews, which are informal give-and-take sessions, we determine, and attempt to resolve, problem areas.

The DSA Command Objectives Program places maximum emphasis on identifying the main jobs to be done, on establishing a timetable for completing all actions, on determining who is to take action, and on keeping performance factors in sharp focus so that manrgement can react with timely, responsive decisions.

In addition to the Resource Management System and the Command Objectives Program, the operations control "loop" is closed by the management review system. Through this system top management can critically review the results of its operations. These reviews are the forums for collective consideration of actual or potential problems. Several different management techniques are used to follow up on performance and improve agency communications.

For example, there are weekly meetings between the Director and the principal DSA staff. Each month DSA's Comptroller presents a performance evaluation of the entire agency. Also, every month one meeting includes a general intelligence summary by a representative of the Defense Intelligence Agency. This keeps the senior staff and the Director abreast of world developments which may impact on DSA support of the Military Services.

Conferences attended by commanders of the major field activities are held bi-monthly. Once a year a three-day conference is held with field commanders and headquarters principal staff members for a deep and thorough review of the agency's operations.

DSA semi-annual staff reviews usually last three days, and provide the Director with an in-depth review of current and pending staff action.

Weekly Highlight Reports summarizing events throughout the agency are routed to all staff elements; they provide field commanders and staff officers an additional channel for informal reports of general interest.

Inspector General reports provide information and recommendations concerning efficiency, effectiveness, economy, morale and discipline within the headquarters and field activities. Auditor General reports, which are similar to Inspector General reports in that they are made by a non-operating official responsible only to the Director, are our internal audit process. Those reports help me assure that management controls, at all levels of our operations, are adequate, effective and properly applied.

This array of management information, analysis and evaluation of DSA's diversified operations provides the Director necessary information on all facets of DSA performance and goes a long way toward avoiding unwelcome surprises.

Transportation Management

To this point, this article has dealt with the broad aspects of DSA management. Let us now focus attention on a particular functional area—transportation management.

The traffic management role of DSA is to insure that materiel is delivered to the proper destination at the required time, in good condition, and at the lowest reasonable cost.

Within the Defense Department logistics systems, DSA is responsible for the first and second destination movement of supplies which it manages. First destination responsibility concerns the movement of materiel from the producer into the DSA distribution system. Second, DSA moves the materiel from storage or distribution points to the military customer. Direct vendor deliveries are made whenever feasible and timely.

To carry out its task, DSA maintains the closest working relationship with the Military Traffic Management and Terminal Service (MTMTS). MTMTS, under the Department of the Army, provides a traffic management service in the continental United States to all Military Departments (an inter-Service arrangement paralleled by the Military Sea Transport Service under the Navy and the Military Airlift Command under the Air Force). DSA receives information on more than a quarter million MTMTS traffic management actions annually and has become its largest customer.

Actually, DSA must do business with the transportation systems of al the Military Services. Each Service has its own system to meet its particular transportation needs. The DSA mission is to put the supplies th Service specifies into its transportation system. To do so, DSA must understand the Services' transportatior systems and reflect the needs of th Services in planning DSA operation: Also, DSA must stay abreast of developments in each Service, and mak maximum use of advances in thei technology.

The agency's traffic managemen and transportation activities are exten sive. In a single month, DSA handl 14,500 truckloads and 3,500 railca of materiel. This represents abo

85,000 short tons in and 111,000 short tons out of the system each month, and involves the processing of some 27,000 bills of lading for inbound and 52,000 for outbound shipments monthly. In FY 1968, the depots received 1.3 million short tons of supplies in 89,000 truckloads and 28,000 railcar loads. In addition, depots received approximately 436,000 parcel post shipments. During FY 1968, depots shipped 1.5 million short tons of supplies in 133,000 truckloads and railcar loads, and sent 8.7 million parcel post shipments. Second destination transportation cost $63.4 million in FY 1968.

The DSA Defense Contract Administration Services (DCAS) has within its organization a transportation entity to manage that part of the procurement function. DCAS issues half a million government bills of lading (GBL) a year via all modes of transportation.

One innovation in the DCAS transportation function illustrates the fact, earlier mentioned, that DSA utilizes techniques of each of the Military Services. Under a technique borrowed from the Air Force, a DCAS field representative will evaluate a contractor's traffic management capability and place blocks of signed GBLs with him. Thereafter, the contractor himself completes and executes the GBL and, in many cases, deals directly with MTMTS for specific routings. Generally, where loads do not require dealing with MTMTS, the contractor selects commercial shipping routes.

In another innovation, DCAS has successfully service-tested the mechanization of the GBL register and can extract data heretofore not available. That data gives a clear picture of the distribution of tonnage by mode, weight and cost into various destinations. From such data, DSA managers can plan consolidation, containerization and transportation eco-

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points consistent with consumption patterns. Slow-moving, insurance-type items and high-value items are positioned at the fewest number of locations consistent with known user needs. Items requiring special storage conditions are positioned at locations having the needed capability.

Positioning of stocks has received considerable attention lately. The situation in Southeast Asia focused attention on the fact that our logistics system had been deliberately oriented toward Europe. About 69 percent of the deliveries are presently made to customers in the Pacific area. With the majority of DSA depots located east of the Mississippi River, we do not have sufficient open and covered storage in the general area of West Coast terminals. However, before starting a crash program to build or lease additional space, we considered the transportation aspects of the problem. We found that customers could be supported from the eastern depots with no appreciable increase in transit time, and with some lower overall costs to the Government. Overall cost covers the total transportation bill—inland freight, port handling charges, ocean carriage and discharge costs—to move a shipment by various routings from the contractor's plant or defense depot to the oversea customer. Some commodities can be shipped to Southeast Asia from East Coast ports at a lower overall cost than shipping across country to an ocean terminal on the Pacific coast.

The lowest overall cost can also be considered for air shipments. In view of the size and speed of present cargo aircraft, and the imminent introduction of the C-5A into the defense inventory, selection of a departure airfield in the United States closest to the overseas customer is no longer a major consideration.

Last year, DSA started a uniform shipment plan to achieve two major operational improvements. First, transportation knowledge is put to work at the beginning of the shipment planning cycle and, second, artificial constraints on shipment consolidation were abolished.

Keeping up with new innovations, DSA use of intermodal containers is rapidly increasing. These containers can be transported over the road on wheeled frames, by rail on flatcars, and aboard ship, either on deck or in specially designed hatch space. Depending on design, containers can be used for a variety of cargoes, including liquids and refrigerated perishables.

Reduced handling, pilferage, spoilage and damage in container shipments contribute to greater efficiency over conventional methods. Off-loading time is reduced. Perishable foods, which are not suitable for conventional methods, can be shipped overseas in containers. For example, our fighting men in Vietnam have enjoyed tons of fresh sweet corn which was transported in refrigerated containers.

DSA is also prepared to meet various transportation emergencies, ranging from regional labor-management disputes to general nuclear war and the imposition of government controls over civil transport. During the planning phase, DSA participation has been primarily with Defense Department offices. DSA will establish close coordination with other Federal agencies and carrier associations.

One more transportation subject brings us full cycle, back to the DSA mission stated at the beginning of this article. We are constantly aware that everything we do must contribute to putting needed supplies in the hands of the user, when, where, and how he wants them. Consequently DSA has systems and procedures to evaluate how well we are doing the job.

A traffic management quality assurance program has been developed and implemented—the Military Supply and Transportation Evaluation Procedures (MILSTEP). This system measures total pipeline reaction time, point-to-point and carrier performance reports. A central data collection point receives intransit data for each GBL and for each shipment unit moving overseas. A central processing point matches these intransit data with supply item information and produces total pipeline reports.

The purpose of MILSTEP is twofold. First, it insures that the supply and traffic management operations at our centers and depots meet the standards set for them. Second, it assures that these services are provided as economically as possible. As we find weak points, necessary corrective steps will be taken.

Improved Purchasing Techniques

The overview of DSA management which I have here presented would be incomplete without mention of the intense management attention being given to improvement of purchasing techniques.

Many readers are aware of the wide press coverage given last spring to some examples of poor buys by DSA and other elements of the Defense Department. Needless to say, a great deal of management effort has been expended to determine the incidence of overpricing and its causes, and to correct deficiencies.

Before going into specifics, some statistics will, hopefully, put the problem into perspective. In FY 1968 DSA executed about 848,000 individual purchase actions, totalling about $5.3 billion. About one-third of these were large buys (over $2,500), accounting for about 94.6 percent of the dollars. Problems in this area were minimal, largely because of the intensive management attention applied to big dollar buys. Small buys, under $2,500, reached a surprising total of over $289.4 million, and encompassed over 597,000 transactions averaging about $48 each.

By using statistical sampling techniques, we found during FY 1967 that approximately 94 percent of our small purchases met very strict criteria and were reasonably priced. We applied a similar sampling technique to the three months ending January 1968 and found that improvement efforts had paid off. Overpriced purchases had been reduced by about two-thirds, so that only some 2 percent remained susceptible to overpricing.

During the past two years DSA managers have devoted primary efforts to responsive support of the military forces operating in or assigned to Southeast Asia. Under the Vietnam buildup, DSA's small purchase workload doubled at many purchasing offices and the number of urgent orders increased sharply. Many new junior buyers were hired, and it became necessary to place considerable responsibility on them even though time did not permit thorough training. In addition, some buying offices have experienced a 50 percent turnover of personnel in the last three years, with the heaviest losses among trained buyers. Nevertheless, grossly overpriced purchases are not typical of DSA small purchase operations.

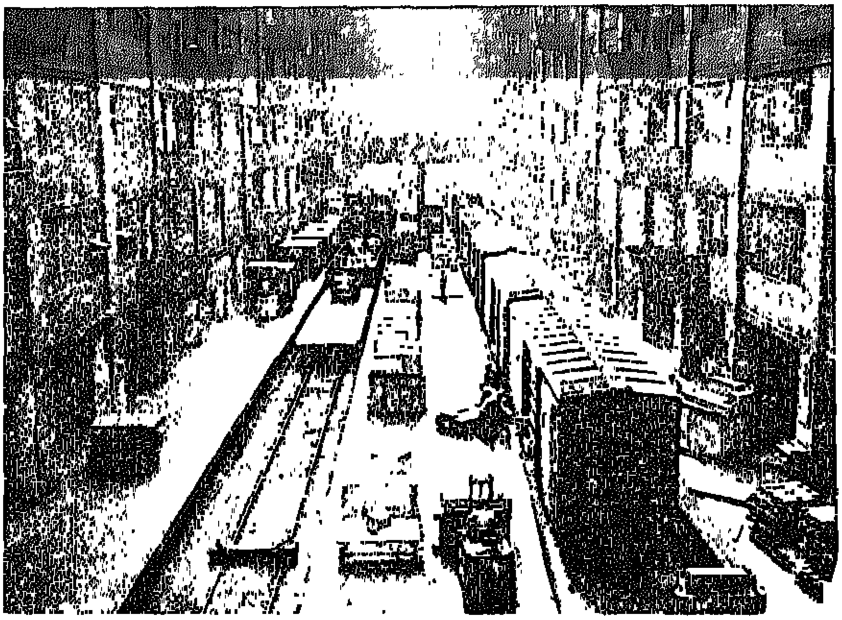
Examination of the causes showed no paucity of sound policy nor lack of techniques for making good purchases. The greatest shortfall was in providing buyers with adequate technical information and adequate training and supervision.

Although all the problems have not been fully solved, improvements have been made. Quality of personnel has been improved by upgrading their training, pay and guidance. Contractors' pricing policies are scrutinized more closely. Better item data is obtained. Paper flow is being reduced by increased automation in the purchasing function.

In a memorandum issued to the Military Services and DSA on the selection of responsible contractors, the Secretary of Defense reemphasized the importance of selecting only fully qualified sources. In keeping with this direction, we continue to improve techniques for screening potential suppliers. For example, DSA has recently installed a contractor experience list, which includes names of those contractors whose performance has been less than satisfactory. These firms are not excluded from bidding, but before a contract is awarded to one of these firms, the contracting officer is alerted to the need for detailed review and evaluation, including a pre-award survey of the firm. In addition, procurement regulations now define more precisely the circumstances under which pre-award surveys will be performed and the depth of the surveys in determining production, quality and financial capabilities. Regulations also establish standards to be met if a pre-award survey is not to be made. This involves full justification for waiver of the survey, as well as higher level management review of high-dollar-value awards. This added guidance should more rigidly safeguard against awards to marginal producers.

The military operations in Southeast Asia have provided a most severe test of the concept on which DSA was founded, and of its logistics management policies and procedures. DSA managers and personnel are acutely aware of our position in the logistics support picture: our customers depend solely on us for service—there is no other source. This sense of military urgency permeates the headquarters and field activities, and we are constantly seeking better ways to respond to our customers' changing needs.

There is a continuing need for management improvements. This challenges every manager at every level of DSA operations.



TRANSFER TERMINAL of Eastern Area MTMTS, through which Defense Supply Agency ships supplies to its customers.

DEFENSE S

Cameron Sta
Teleph

LIEUTENANT GENERAL EA

MAJOR GENERAL ROBERT

EXECUTIVE, COLONEL E

Editor's Note Organization charts appearing in the Bulletin are edited by the editorial staff to reflect those elements of the various DOD organizations which are of interest to industry representatives Organizational elements not involved in the DOD-industry relationship have been eliminated because of space limitations

The information on personnel, room and telephone numbers is as current as is possible to obtain at the time we go to press Basic information in this chart was extracted from the Defense Supply Agency organization chart dated Oct 1 1968, and is updated insofar as was possible.

COUNSEL

Counsel		
R M Lemke	3D330	46156
Associate Counsel		
W P Weston	3D322	46165

INSPECTOR GENERAL

Inspector General		
Col R I Ciraldo, USA	3C325	46057
Deputy Inspector General		
Col R L Renker, USAF	3C325	46058

ASSISTANT DIRECTOR PLANS, PROGRAMS AND SYSTEMS

Assistant Director		
RAdm J F Haddock, USN	3A426	46271
Deputy Assistant Director		
Brig Gen R H Spanjer, USMC	3A426	46487
Executive Officer		
Lt Col E C Merkl, USA	3A426	46274

COMP

Comptroller
M H Baker
Deputy Comptroller
Col A A Tisone, USAF
Executive Officer
Lt Col G V Wise, USA

EXECUTIVE DIRECTOR SUPPLY OPERATIONS

Executive Dir, Maj Gen T H Scott Jr, USA	4D276	46101
Deputy Executive Director, E H Neese	4D276	46102
Executive Officer, Col J P Baikman, USA	4D276	46104
Logistics Programs Div, Chief, A P Roberts	4C261	46097
Supply Mgt Div, Chief, Capt L F ReDavid, USN	4B455	46091
Emerg Supply Ops Cen, Lt Col G Kaden, USAF	4D327	46171
Civil Def Materiel Div, Chief, M V Williams	4C456	47667
Depot Opns Div, Chief, Col W A Steiger, USA	3D240	46094

EXECUTIVE DIRECTOR PROCUREMENT AND PRODUCTION

Executive Director, Brig Gen R E Lee, USAF	4D231	46401
Deputy Executive Director, D R Bablone	4D231	46403
Executive Officer, Lt Col J B Fagan, USAF	4D231	46402
Small Business Advisor, J F Ross	4C128	46471
Procurement Div, Chief, H Margulis	4D152	46417
Production, Quality and Reliability Div, Chief, Col P B Henshaw, USA	4B163	46441

EXECUTIVE DIRECTOR TECHNICAL AND LOGISTICS SERVICES

Exec Dir, Brig Gen J A Brooks III, USAF	4D530	46[illegible]
Deputy Executive Director, R G Bruner	4D530	46[illegible]
Executive Officer, Lt Col J B Booth, USAF	4D530	46[illegible]
Programs & Analysis Div, L Trenary	4D514	4[illegible]
Cataloging & Tech Data Div, Chief, S Schatz	4D558	4[illegible]
Utilization Div, Chief, Col R Savilla, USA	4D570	[illegible]
Disposal Div, Chief, P M Somerville	4C541	4[illegible]
Engineering Programs Division, Chief, Capt R O Lewis, USN	4A586	4[illegible]
R&D VE/VA Advisor, E O Kruegel	4B476	4[illegible]

MAJOR FIELD ACTIVITIES

SUPPLY CENTERS

DEFENSE CONSTRUCTION SUPPLY CENTER
Columbus, Ohio 43215
Telephone 236 + Ext. Area Code 614

Commander, Maj Gen E M Tally, USAF	2166
Deputy Commander, Col J H Ford, Jr., USA	2167

DEFENSE ELECTRONICS SUPPLY CENTER
1507 Wilmington Pike, Dayton, Ohio 45401
Telephone: 252-6551 Area Code 513

Commander, Brig Gen G J McClernon, USAF	28141
Deputy Commander, Capt T B Purvis, Jr., USN	21145

DEFENSE FUEL SUPPLY CENTER
Cameron Station, Alexandria, Virginia 22314
Telephone 974-7401 Area Code 202

Commander, RAdm F W Martin, USN	47401
Deputy Commander, Col L Stann, USAF	47403

DEFENSE GENERAL SUPPLY CENTER
Richmond, Virginia 23219
Telephone 275-3861 Area Code 703

Commander, Brig Gen J D Hines, USA	3000
Deputy Commander, Capt T H Dawson, III, USN	3200

DEFENSE INDUSTRIAL SUPPLY CENTER
700 Robbins Ave, Philadelphia, Pa. 19111
Telephone 697 + Ext. Area Code 215

Commander, RAdm G C Heffner, USN	2300
Deputy Commander, Col I J Kirshrot, USA	

DEFENSE PERSONNEL SUPPORT CENTER
2800 S 20th St., Philadelphia, Pa. 19101
Telephone 271 + Ext Area Code 215

Commander, Brig Gen W M Mantz, USA	2300
Deputy Commander, Col D G Bussey, USAF	3002

DEPOTS

DEFENSE DEPOT MECHANICSBURG
Mechanicsburg, Pennsylvania 17055
Telephone 766 8911 Area Code 717

Commander, Capt C J Stringer, USN	2324
Deputy Commander, Col C M Anderson, USAF	2382

DEFENSE DEPOT MEMPHIS
Memphis, Tennessee 38115
Telephone 743-3410 Area Code 901

Commander, Col T I Martin, USA	411
Deputy Commander, Capt K Bennett, USN	412

DEFENSE DEPOT OGDEN
Ogden, Utah 84401
Telephone: 399-7011 Area Code 801

Commander, Col R B Ladd, USAF	7021
Deputy Commander, Capt R H Haslett, USN	7938

DEFENSE DEPOT TRACY
Tracy, California 95376
Telephone 835-0800 Area Code 209

Commander, Capt R C Dexter, Jr., USN	5219
Deputy Commander, Col R A Riddle, USA	5208

SERVICE CENTERS

DEFENSE DOCUMENTATION CENTER
Cameron Station, Alexandria, Virginia 22314
Telephone 974-6916 Area Code 202

Administrator, Dr R B Stegmaier, Jr.	46800
Deputy Administrator, A G Abdian	46882

DEFENSE INDUSTRIAL PLANT EQUIPMENT CENTER
Defense Depot Memphis, Memphis, Tenn. 38102
Telephone 743-3410 Area Code 901

Commander, Capt H D Byrd, USN	501
Executive Director, H R Carrington	502

DEFENSE LOGISTICS SERVICES CENTER
Federal Center, Battle Creek, Michigan 49016
Telephone: 962 6511 Area Code 616

Commander, Capt R A Porter, USN	6666
Deputy Commander, Col R A Marsh, USAF	6668

DEFENSE SUPPLY AGENCY ADMINISTRATIVE SUPPORT CENTER
Cameron Station, Alexandria, Virginia 22314
Telephone, 974-6003 Area Code 202

Commander, Col S A MacKenzie, USA	46003
Deputy Commander, Col J H Vines, USAF	46004

AGENCY
Va 22314
Ext

USAF	3A150	46111
R		
	3A150	46113
R USA	3A150	46115

DEPUTY DIRECTOR (CONTRACT ADMINISTRATION SERVICES)

Deputy Director RAdm J L Howard USN	8A320	47091
Asst Deputy Director, W R Senter	8A320	47091
Executive Officer, Lt Col M J Tasnjian USAF	8A320	47091

	3D528	46201
	3D528	46203
	3D528	46204

SPECIAL ASSISTANT FOR PUBLIC AFFAIRS

Special Asst for Public Affairs E F Hart	3A210	46135
Deputy Special Asst for Public Affairs H L Schon	3A215	46242
Military Asst for Public Affairs Cdr W L Frelander, USN	3A210	46135

OFFICE OF PLANS AND MANAGEMENT

Chief J E Pernice	8A334	47571
Deputy Chief Cdr T R Downs USN	8A334	47571
Executive Officer Cdr J G Tapp, USN	8A334	47571

OFFICE OF MANAGEMENT REVIEW

Chief Col F G Everett Jr, USA (Acting)	8A349	47570
Deputy Chief H W Peterson	8A349	47570

OFFICE OF MANAGEMENT CONTROL

Chief Lt Col J B Pompan, USAF	8B343	47550

OFFICE OF INDUSTRIAL SECURITY

…f, Col B C Marshall, USAF	8A392	47594
…ty Chief, G H Davis	8A392	47594
…rams & Systems Div, T J O'Brien	8A402	47601
…Mgt Div, Lt Col B C Young, USA (Acting)	8A415	47701
…rnational Programs Div, J J Norton	8A398	47591

OFFICE OF CONTRACTS COMPLIANCE

Chief, M R Shafer	8A489	47201
Programs & Systems Div, J Shannon	8A489	47201
Field Operations Div, A R Jarrett	8C250	47101

EXECUTIVE DIRECTOR CONTRACT ADMINISTRATION

…cutive Director, Col E H Robertson, USAF	8A430	47704
…uty Executive Director, W V Gordon	8A430	47705
…cutive Officer, Lt Col W K Dickson, USAF	8A430	47706
…ancial Svcs Div, Cdr R M McDaniel, USN	8A471	47615
…tract Div, Col W J Keating, USA	8B461	47625
…ustrial Property Mgt Div M Reinstein	8A454	47707
…ns & Policies Ofc, B Eisenstein (Acting)	8B427	47731
…PR Contract Admin Panel Mbr, R E Rodney (Alternate)	8B427	46787
…st for Small Business, G C Tolton	8B390	47605

EXECUTIVE DIRECTOR PRODUCTION

Executive Director, J S Groupe	8D425	47647
Deputy Executive Dir, Col W A Fickling, USAF	8D425	47648
Executive Officer, Maj D E Press USA	8D425	47649
Industrial Labor Relations, D J Bertsch	8D458	47661
Production Mgt Div, Capt M Cohn, USN	8D435	47651
Industrial Resources & Mobilization Planning Div, H F Eichelkraut	8C403	47764
Systems & Engr Div, Col L W Worthing, USA	8D416	47544
Trans & Traffic Mgt Div, T B Gudis	8B402	47721

EXECUTIVE DIRECTOR QUALITY ASSURANCE

Executive Director, Col J C Coyne, USA	8D468	47754
Deputy Executive Director G J Soares	8D468	47754
Executive Officer, Maj F P Norrod, USA	8D477	47756
Mat Quality Div, Col W A Bridenstine, USA	8C479	47658
Plans & Policies Div T M Vining	8D490	47745
QA Engineering Div, G G Gula	8C444	47785
Spec Safety & Flight Opns Div, Lt Col L E Ward, USAF	8D490	47655

MAJOR FIELD ACTIVITIES

DEFENSE CONTRACT ADMINISTRATION SERVICES REGIONS (DCASRs)

DCASR ATLANTA
3100 Maple Drive, N E, Atlanta, Ga. 30305
Telephone 261-7310 Area Code 404

Commander, Col L P Murray, Jr., USAF	411
Deputy, C T Patterson	412

DCASR DALLAS
500 South Ervay St. Dallas, Texas 75201
Telephone RI 9-2371 Area Code 214

Commander, Capt W G Normile, USN	RI 9-2371
Deputy, P H Packard	RI 9-2373

DCASR PHILADELPHIA
2800 S. 20th St, Philadelphia, Pa. 19101
Telephone 271 + Ext. Area Code 215

Commander, Col G Johnson Jr , USA	4000
Deputy, W F Rathgeber, Jr.	4002

DCASR BOSTON
666 Summer Street, Boston, Mass 02210
Telephone 542 6000 Area Code 617

Commander, Col F A Bogart, USA (Capt R R Campbell, USN)*	405
Deputy, H L Finn, Jr.	410

DCASR DETROIT
1580 E. Grand Blvd, Detroit, Michigan 48211
Telephone 923-0100 Area Code 313

Commander, Col W B Dudley, USAF	201
Deputy, E Richter	203

DCASR ST. LOUIS
1136 Washington Avenue, St. Louis, Mo. 63101
Telephone AM8-1000 + Ext Area Code 314

Commander, Capt R S Sullivan, USN	6210
Deputy, E S Crawford	6211

DCASR CHICAGO
O'Hare International Airport
P.O Box 66475, Chicago, Ill., 60666
Telephone 694-3031 Area Code: 312

Commander, Capt R A Schauffler, USN	2360
Deputy, P Giannini	2361

DCASR LOS ANGELES
11099 S La Cienega Blvd
Los Angeles, Calif, 90045
Telephone 643 + Ext, Area Code, 213

Commander, Brig Gen A E Exon, USAF	0230
Deputy, R H Thompson	0554

DCASR SAN FRANCISCO
866 Malcolm Road, Burlingame, Calif. 94010
Telephone, 692 0300 Area Code 415

Commander, Col W K Ashby, USAF	201
Deputy, H E Gardner	204

DCASR CLEVELAND
Federal Office Building
1240 East 9th Street, Cleveland, Ohio 44199
Telephone 522 + Ext, Area Code: 216

Commander, Col O G Miller, USA	5100
Deputy, W E Tisdall	5103

DCASR NEW YORK
60 Hudson Street, New York, N.Y. 10013
Telephone: 264 + Ext, Area Code, 212

Commander, Brig Gen C H Phipps, USA	0900
Deputy, P J Coughter	0901

*Expected to assume office as of February 1, 1969.

Item Management
n the Defense Supply Agency

The Defense Supply Agency is the logical result of an evolutionary process by which the Defense Depart- ient has applied the concept of inte- rated management in the area of ommon support of supplies and serv- es.

"Single Manager" agencies estab- shed within the Military Depart- ients, at the direction of the Secre- iry of Defense, starting in 1955, re- uced supply inventories and oper- ting costs, while maintaining effec- ve support of the Army, Navy, Air orce and Marine Corps.

After a survey of their accomplish- ients and the possible extension of itegrated management into other reas, conducted by the Office of the ecretary of Defense and the Military epartments in 1961, the Secretary of efense announced on Aug. 31, 1961, iat the Defense Supply Agency)SA) would be established to ianage the procurement and distribu- on of common supplies and to per- rm related services.

DSA is the consolidated wholesaler r assigned items of supply, and dis- ibutes from the depot level in the nited States. It supports Air Force id Army installations world-wide. ie Military Services determine gross quirements and, with the Joint iiefs of Staff, establish priorities. iA computes net requirements, pro- res supplies from commercial urces, and sells to the Services at st plus surcharge for transporta- n. Reimbursement from customers lenishes the DSA Stock Fund. It is is fund which provides the working pital for DSA procurement actions.

Material mission assignments are ide to DSA by the Office of the Sec- ary of Defense (Installations and istics) [(OASD (I&L)] on Fed- il Supply Class (FSC) basis within fined commodity groupings. These nmodity groupings are medical, sistence, clothing, electronics, con- uction, industrial, chemical and ieral supplies. In the medical, sub- tence and clothing commodities, all ms in the attendent classes are assigned to DSA for integrated management. In the remaining commodities, items are selected for assignment to integrated management by DSA through a process known as Item Management Coding.

Item Management Coding (IMC) is a process by which all items, having been assigned Federal Stock Numbers and classified in DSA-assigned classes, must be reviewed against criteria established by OASD (I&L) for determination as to whether the individual items will be retained for Service management by the Service introducing the item, or will be subject to integrated management by DSA. From 1962 to 1964, item management coding was performed under a rather general criteria which resulted in a high percentage of items in DSA-assigned classes remaining under Military Service management.

In March 1964, OASD(I&L) established a study by DSA and the Military Services to identify problems associated with the interpretation and application of existing criteria, and the development of a more definitive set of criteria capable of uniform application by all DOD coding activities. This study was completed in November 1964, and the new criteria were approved by the Defense Materiel Council in April 1965. The revised criteria provided that major end items, depot repairables, design/engineering/source controlled items be retained for Service management, and that standard repair parts and consumable type secondary items be assigned for integrated management by DSA.

With the approval and promulgation of the new criteria, OASD(I&L) directed application to all items which had been previously coded for Service management, as well as to all new items entering the DOD system in DSA-assigned FSCs. This review and application of the new criteria became known as the Retroactive IMC Program.

The Retroactive IMC Program was scheduled to begin July 1, 1965, and to be completed Dec. 31, 1967, and included the review of 975,000 items. The result was that 535,000 items were coded for integrated management by DSA. At the close of FY 1968, the DSA integrated management package totaled 1,964,200 items, approximately 80 percent of the total items in the 286 DSA-assigned classes. In addition, there has been an average of approximately 60,000 new items per year introduced into the DOD system by the Military Services and coded by DSA management, plus approximately 60,000 new items as a result of provisioning. This is considered normal item growth under present conditions.

While the new item growth con tinues, a companion program, the In active Item Review Program, is i effect which influences the DSA iten management package and tends t maintain it relatively stable. Unde the procedures of this program, al items which have been managed b DSA for a period of 21 months as result of IMC or for 36 months as result of provisioning, without demand, are referred to the usin Service for review, pursuant to elimi nation of the items as no longer re quired to support Military Service programs. It is anticipated that thi program will result in the eliminatio of 100,000 plus items annually fron DSA management during the nex several years.

The method of management vari with commodities and among specifi items. Basic policy is to apply man agement techniques which will be re sponsive to requirements of the Mili tary Services under the Uniform Ma teriel Movement and Issue Priorit Systems, with maximum efficiency an economy. The methods of managemen applied to DSA-managed items rang from those which are centrally pro cured, stocked and issued; to thos which are procured centrally fo direct delivery to customers; and t those which are designated for loca purchase by the requiring activity Criteria have been established for us by the Defense Supply Centers in de termination of the appropriat method of management to be applie to items under their management.

The concept of integrated manage ment of common supplies by DS continues to progress and is recog nized as an efficient management con cept in military supply logistics.

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Defense Documentation Center
Cameron Station
Alexandria, Va. 22314

All organizations may purchase microfiche copies (65¢) or full-size copies ($3) of the documents (unless otherwise indicated) from:

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Work Breakdown Structures for Defense Materiel Items

E. J. Nucci
A. L. Jackson, Jr.

The concept of using a work breakdown structure (WBS) in project planning and control is not new. In fact, WBS has been used extensively as a management tool by the Defense Department and its industrial contractors in developing and acquiring military systems and equipment for some time.

In essence, a WBS effort focuses on systematically dividing the total job at hand into manageable pieces, which together constitute some total product desired. This is a normal, logical approach to any problem or project, especially one that is large or complex.

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Experience with this tool revealed, however, that the principal managers in a project—development, production, financial, procurement, logistics, etc. (often called "functional managers")—were tailoring breakdown structures to their own individual functional needs. From this there emerged a recognition of the desirability, even necessity, for a WBS system that would provide for a specific contract/project a single WBS that could serve as a common framework for all the functional managers without disturbing their individual needs. Accordingly, a new, unifying dimension of the concept was added by DOD Directive 5010.20, "Work Breakdown Structures for Defense Materiel Items," dated July 31, 1968.

This article is a review of the background events leading up to the need for such a policy directive, and the purposes and relationships of the WBSs in the areas of system/project management, systems engineering, configuration management, integrated logistic support, procurement, and cost and information reporting.

What is WBS?

As the term implies WBS is a technique for breaking down a total job into its component elements, which then can be displayed in a manner to show the relationship of these elements to each other and to the whole. The WBS display is much like the familiar organization charts used to show the complete structure of a large firm, its organizational sub-elements and their interrelationships. In the context of a system/project, WBS provides a schematic portrayal of the products (hardware, software, services, and other work tasks) that completely defines the system/project. This structure results from the project engineering effort during development and production of the given system/project.

Background

In the past decade the development and production of military systems and support equipment have been characterized by an increasing trend toward greater functional complexity and a demand for higher readiness capability. The attendant problems led functional managers to develop new techniques and methods aimed at improving technical and management control of programs and projects. Many of these techniques, *e.g.*, cost reporting, configuration management, specification tree, contract line item structure, PERT/Cost, employed a form or structure similar to those used in WBS.

There was a valid need for these and other techniques, and benefits to be gained from their use. Basically, however, they were developed independently and were applied as separate requirements in contracts. Thus, a single contract often contained several different, unrelated breakdown structures in addition to the basic WBS.

Under these circumstances, an opportunity was seen to improve overall project management by providing functional managers with a common reference base for communicating and

making decisions of mutual interest. Accordingly, the principals concerned with research and development, financial management, and procurement/production in the Office of the Secretary of Defense agreed on the desirability of a uniform WBS that would satisfy all management functions, and on the need to determine whether or not existing practices were causing special problems. In August 1965 the Director of Defense Research and Engineering initiated a study to analyze existing WBS practices and requirements, which had the following basic objectives:

- To develop guidelines for the preparation and application of a WBS for a single project that would satisfy multiple user needs in DOD and industry, as regards both management planning and control within a project and external information reporting.
- To develop a practical minimum of uniform WBSs that could be applied to the widest possible variety of both large and small system/projects.

As part of the study, WBSs of some 70 different system/projects were analyzed. From the study and other experiences, a set of problems were identified as relating to existing practices:

Misunderstandings and Confusion Caused by WBS Practices. The variations and inconsistencies in how the various DOD agencies were applying WBSs in contracts (with differing element definitions, varying structural arrangements, etc.) caused confusion and delay both for DOD and contractors. They were particularly burdensome for the large number of contractors that did business with more than one DOD customer.

Inability To Evaluate Comparable Efforts. It was difficult to compare and evaluate planned work efforts and products in competitive proposals owing to the lack of uniform terminology and definitions of scope of WBS elements. Similarly, the comparability of efforts between similar systems/projects was difficult to determine. Also, as a corollary, it was hard to transfer experience gained on one program to a similar follow-on program.

Inability To Evaluate Completeness of Project. Project managers were having difficulty in determining the completeness of the project work when they did not have a checklist of all the work to be considered in the system design and management.

Burden on Contractors of Overlapping Management Reporting Requirements. Where contracts included several (up to seven) unrelated breakdown structures (to satisfy different management control and reporting requirements), contractors were having to reorient and regroup their management data and control systems. Often they had to establish redundant data collection and reporting procedures which were not related to the way the work was being accomplished.

Constraints on Design and Development. WBSs were causing constraints on the design and development process, as well as on project management, in those cases where they were being included in contracts at too low a level of detail.

To begin to find a solution to these problems, the study recommended a set of policies and guidelines for the structuring and application of WBSs in projects for systems and major equipments. A draft DOD directive on WBS policies was proposed, along with a draft military standard for applying these policies in contracts.

The suitability of WBSs prepared and used in accordance with the criteria set forth in these preliminary documents was then demonstrated by a pilot test in which they were applied and analyzed in relation to three different major system developments. Further, these documents were reviewed, and an unusual degree of concurrence was achieved as to their need throughout DOD and industry. When reviewed as part of the DOD/CODSIA[1] study of management systems control, three task groups validated their need and specifically endorsed the proposed product-oriented type WBS.

Finally, the two documents served as the basis for DOD efforts to develop DOD Directive 5010.20, "Work Breakdown Structures for Defense Materiel Items," and the MIL-STD-881 (same title) which was coordinated with industry through CODSIA before publication.

[1] *DOD/CODSIA (Council of Defense and Space Industries Association) Advisory Committee for Management Systems Control, Final Report "Management Systems Control," dated March 1968.*

Gains Expected from New Policy Guidance

Both DOD and industrial contractors should benefit from the new policy guidance on WBS, because it was developed to solve and prevent the recurrence of mutual problems that have arisen in current programs. The following benefits are envisaged:

- Contractors will not be burdened with several unrelated breakdown structures in a single contract, let alone the unwarranted differing WBS requirements from their many DOD customers.
- Ability to compare similar work efforts will be improved, and experience will be transferable to similar new programs.
- The total project's visibility to management will be increased, and all management information will stem from a single framework related to how the work is accomplished.
- The cost of satisfying management's information needs for new programs will be reduced.
- Managers will operate at levels necessary to assure program success and yet preserve the flexibility needed in design, development and production for achieving the desired product.
- Improved defense systems will be acquired at a lower total cost.

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SUMMARY WORK BREAKDOWN STRUCTURES (SUMMARY WBS)

CATEGORIES OF DEFENSE MATERIEL ITEMS

AIRCRAFT

Level 1 AIRCRAFT SYSTEM
- Level 2 AIR VEHICLE
  - Level 3 Airframe
  - Power Plant
  - Other Propulsion
  - Communications
  - Navigation/Guidance
  - Fire Control
  - Penetration Aids
  - Reconnaissance Equipment
  - Automatic Flight Control
  - Anti-Submarine Warfare Equipment
  - Central Integrated Checkout
  - Armament
  - Weapons Delivery Equipment
  - Auxiliary Electronics Equipment

Level 2 PECULIAR SUPPORT EQUIPMENT
- Level 3 Organizational/Intermediate
- Depot

COMMON SUPPORT EQUIPMENT
- Organizational/Intermediate
- Depot

SYSTEMS TEST & EVALUATION
- Development Tests
- Technical Evaluation
- Operational Evaluation
- Test & Evaluation Support
- Mock-Ups
- Test Facilities

MISSILES

Level 1 MISSILE SYSTEM
- Level 2 AIR VEHICLE
  - Level 3 Integration & Assembly
  - Propulsion (For Single Stage Only)
  - Stage I
  - Stage II
  - Stage III
  - Stage IV
  - Guidance and Control
  - Launched Payload
  - Payload Shroud
  - Airborne Test or Training Equipment
  - Auxiliary Equipment

COMMAND & LAUNCH EQUIPMENT
- Integration & Assembly
- Surveillance, Identification and Tracking Sensors
- Data Processing
- Launch and Guidance Control
- Launcher Equipment
- Communications
- Auxiliary Equipment

See (A) above for additional required elements.

SPACE

Level 1 SPACE SYSTEM
- Level 2 SPACE VEHICLE
  - Level 3 Integration & Assembly
  - Spacecraft
  - Propulsion Module
  - Payload
  - Payload Shroud
  - Re-entry Vehicle
  - Orbit Injection/Dispenser

LAUNCH/STAGE VEHICLE
- Integration & Assembly
- Stage I
- Stage II
- Stage III
- Stage IV
- Guidance and Control

GROUND COMMUNICATIONS, COMMAND AND CONTROL EQUIPMENT (PECULIAR)
- Surveillance, Identification and Tracking Sensors
- Communications
- Command and Control
- Data Processing Equipment
- Launch Equipment
- Auxiliary Equipment

FLIGHT SUPPORT OPERATIONS AND SERVICES
- Launch Operations and Services
- Flight Operations and Services
- Recovery Operations and Services

SHIPS

Level 1 SHIP SYSTEM
- Level 2 SHIP
  - Level 3 Hull Structure
  - Propulsion
  - Electric Plant
  - Communication and Control
  - Auxiliary Systems
  - Outfit and Furnishings
  - Armament
  - Integration Engineering
  - Ship Assembly

See (A) above for additional required elements.

SURFACE VEHICLES

Level 1 SURFACE VEHICLE SYSTEM
- Level 2 PRIMARY VEHICLE
  - Level 3 Integration and Assembly
  - Hull/Frame
  - Suspension/Steering
  - Power Package/Drive Train
  - Auxiliary Automotive Systems
  - Turret Assembly
  - Armament
  - Body/Cab
  - Special Equipment
  - Communications and Navigation Equipment

SECONDARY VEHICLE
- (Same as Primary Vehicle)

See (A) above for additional required elements.

ELECTRONICS

Level 1 ELECTRONICS SYSTEM*
- Level 2 PRIME MISSION PRODUCT(S)
  - Level 3 Integration and Assembly
  - Sensors
  - Communications
  - Automatic Data Processing Equipment
  - Computer Programs
  - Data Displays
  - Auxiliary Equipment

*VEHICLE/SITE/PLATFORM
- Select Level 2 and Level 3 from other Categories

*For electronic systems vehicle or platform can be any one of the Level 2 vehicles for the other categories.

See (A) above for additional required elements.

ORDNANCE

Level 1 ORDNANCE SYSTEM
- Level 2 LAUNCH SYSTEM
  - Level 3 Integration and Assembly
  - Launcher
  - Carriage
  - Fire Control
  - Ready Magazine(s)
  - Adaptor Kits

COMPLETE ROUND
- Integration and Assembly
- Structure
- Warhead
- Fuze
- Safety/Arm
- Guidance and Control
- Propellant/Propulsion

See (A) above for additional required elements.

Figure 1.

FOR CATEGORIES OF DEFENSE MATERIEL ITEMS

(A) APPLICABLE TO ALL CATEGORIES (Select as appropriate)

SYSTEM/PROJECT MANAGEMENT	TRAINING	DATA	OPERATIONAL/SITE ACTIVATION	INDUSTRIAL FACILITIES	SPARES & REPAIR PARTS
System Engineering Management/ System Engineering Supporting Project Management Activities	Equipment Services Facilities	Technical Orders & Manuals Engineering Data Management Data Data Depository	Site Construction, System Assembly, Installation & Checkout on Site Site/Ship/Vehicle Conversion Contractor Technical Support	Construction/Conversion/Expansion Equipment Acquisition or Modernization Maintenance	Specify by Hardware Element

See (A) above for additional required elements.

NOTES: 1. Other Level 2&3 elements may be added if necessary (See DOD Directive 5010.20)
2. See MIL-STD- 881 for detailed definition of WBS elements

Application of WBSs

Since management control and project element visibility are the principal objectives of WBS, its greatest value is realized when it is applied to large, complex projects. For this reason, the DOD directive requires that the WBS concept be applied to all new major defense systems and equipments (or major modifications) in engineering development or in operational systems development,[2] and to the production following these development projects. However, the application of a WBS, wholly or in part, may be directed by the responsible DOD agency or by the Director of Defense Research and Engineering to other systems or equipments in engineering development, operational systems development, or follow-on production.

How are WBSs Prepared?

Before pursuing this discussion further, it is important to understand the basic construction of the four principal WBSs that are applicable:

- Summary WBS.
- Project Summary WBS.
- Contract WBS.
- Project WBS.

Each of these structures is composed of a set of *elements* that make up an identifiable product, a set of data, or a collection of services.

Summary WBS. The set of *generalized* structures (shown in Figure 1) are the Summary WBSs for the seven principal categories of defense materiel system/projects—aircraft, missiles, space, ships, surface vehicles, electronics and ordnance. While a complete WBS is the entire "family tree" down to the required level of detail, a Summary WBS relates only to the upper three levels of that "tree." These top levels are prescribed in MIL-STD-881 as to element terminology, definition and placement in the "tree" structure.

Project Summary WBS. This type of WBS is a *tailored* one, prepared by the customer, the DOD component (Army, Navy, Air Force or Defense Agency), by selecting elements applicable to a particular project from one or more of the Summary WBSs shown in Figure 1 to match the project's objectives. Where elements of the Summary WBS are insufficient because of a unique configuration or other special features of the project, additional or substitute WBS elements may be used to make up a Project Summary WBS. Also, items known to be critical to the project may be included as elements in the summary levels or in any lower level as needed.

As shown in Figure 2 (page 26), the first structure in a project is ordinarily a *preliminary* Project Summary WBS developed from the results of the preliminary systems engineering conducted during concept formulation[3] or equivalent effort. The *preliminary* Project Summary WBS is an input and a basis for contract

[2] *Engineering development and operational systems development are development efforts wherein the hardware is engineered for service use (DOD Directive 3200.6).*

[3] *Concept Formulation. The comprehensive system studies and experimental hardware efforts necessary to provide the technical, economic and military bases for a conditional decision to initiate engineering development (DOD Directive 3200.9).*

definition[4] or equivalent effort; changes, if any, in the WBSs resulting from this effort are adopted to establish the *approved* Project Summary WBS.

Contract WBS. Appropriate elements selected from the approved Project Summary WBS are then compiled and used in the Requests for Proposal (RFPs) for the various follow-on development efforts. Necessary adjustments may be made on the basis of contractors' proposals and contract negotiations. During the contract work, the development contractor(s)—or an equivalent in-house activity—by breaking the job into smaller pieces extend the WBS elements negotiated into the contracts, and so develop the Contract WBSs which contain the additional levels necessary to the individual contract effort. The Contract WBS thus portrays all products and work to be accomplished under a specific contract. Note that the elements in the lower WBS levels are defined by the contractor.

Project WBS. The Project WBS, which the DOD component prepares before production, is developed by merging the various Contract WBSs with the Project Summary WBS. Changes to the WBS made during the production will be reflected in the Contract WBS and the Project WBS.

MIL–STD–881 contains the guidance needed to prepare and apply WBSs during the various phases of systems acquisition.

How Is WBS Used?

WBS provides project managers and other interested parties, on a continuing basis, with a visible framework and display of all products and services comprising the entire work effort related to a specific project. It is used as a common base for controlling and reporting the progress and status of engineering efforts, resource allocations, cost estimates, expenditures, and procurement actions throughout development and production. In summary, WBS is used as a common framework to satisfy the needs of the various functional managers—technical, financial, procurement/production, and logistics—involved in a project. These uses are detailed more specifically in the following paragraphs which relate WBS to several important activities pursued in the course of a project.

System/Project Management.

This is the area in which WBS has the greatest use or variety of purpose, because the system/project manager is concerned with all principal areas of management. Since WBS portrays the products and services comprising all work related to the project, the system/project manager uses WBS first to review and assure the completeness of systems engineering in terms of hardware, software, facilities and systems support. Once this breakdown is established, the evolving WBS is used in planning and assigning responsibilities and schedules for accomplishment of the work, including the activities and efforts of interface support groups. The same framework also provides a basis for planning "in-house" and contract efforts, and for allocating resources.

Since the breakdown results from the systems engineering (which reflects the performance allocated to the components of the system/project), WBS provides an excellent framework for monitoring performance, cost and schedule throughout the program. As an allied benefit, the WBS display is a convenient method of highlighting critical items or areas of

[4]*Contract Definition. The initial phase of engineering development to verify or accomplish preliminary design and engineering, develop the necessary performance specifications and management plan to form the basis of a firm contract for the full-scale engineering development (DOD Directive 3200.9).*

DEVELOPMENT AND RELATIONSHIPS OF WBS(s) DURING ACQUISITION

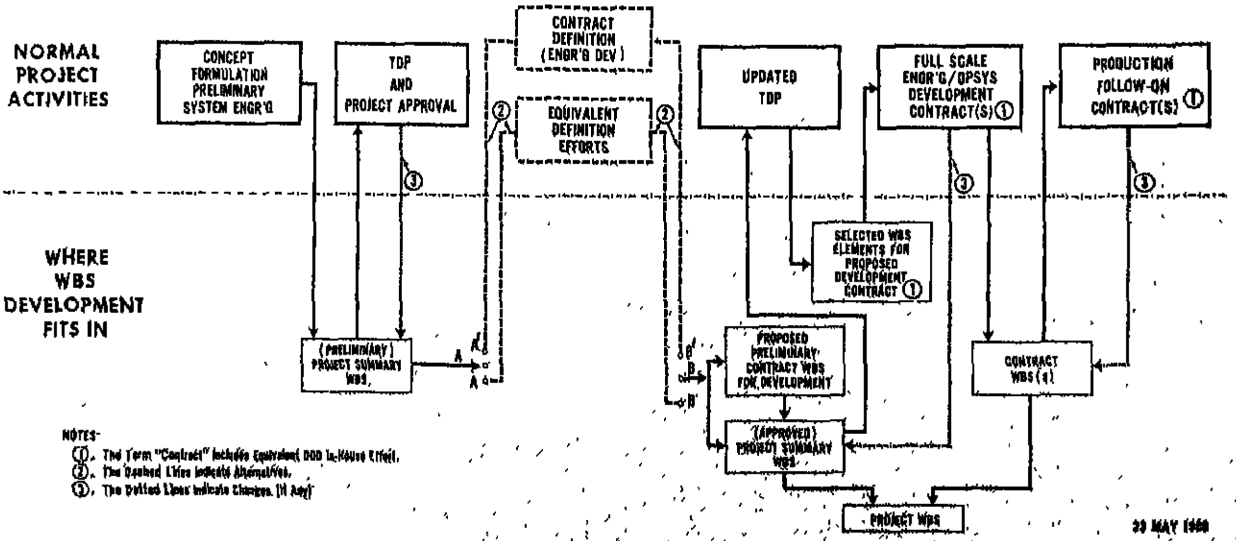


Figure 2.

the project to ensure that they receive the necessary attention by management.

The preliminary Project Summary WBS is submitted as part of the system/project Technical Development Plan and will be evaluated as part of the project approval process. Further, the System/Project Master Plan will include the Project Summary WBS.

It is significant that, while the detailed levels of WBS are always to be available to the system/project manager, DOD management control (aside from critical items) is established through the summary levels of WBS. This provides for adequate management control while retaining contractor flexibility in accomplishing the work (a factor discussed later in connection with cost and management information reporting).

Systems Engineering.

WBS provides a visible documentation of the results and status of systems engineering at any point in time. It has the following uses:

- As a vehicle to summarize all products and services comprising the project's total engineering effort (including the necessary support and other tasks), and to display the relationship of these component efforts to each other and to the whole engineering activity.
- As a tool in reviewing the completeness of the total project engineering effort.
- As a means of highlighting critical items of the project.
- As a framework for developing the system/project "specification tree" needed to describe the configuration base lines.
- As the common framework and basis for monitoring technical performance, cost and schedule; and for making it possible to trace requirements and functions to the hardware.
- As a means of communicating the results of systems engineering to subsequent phases of the acquisition process.

When used as in the last item, the various WBSs are intended to evolve with the project engineering and not steer it. WBS is not to be allowed to interfere with the flexibility needed by the development or production agency to achieve the desired product. Accordingly, the preliminary Project Summary WBS (Figure 2) should be viewed simply as a means of communicating to the contract definition contractor the results of preliminary systems engineering during concept formulation. In no way should this WBS constrain the system definition process. In fact, contractors are encouraged to propose alternative solutions aimed at obtaining an improved product.

Similarly, summary levels of a WBS selected for use in the Request for Proposal in engineering development and operational systems development should be reviewed and adjusted so as to be compatible with the bidder's proposed efforts, provided that they remain consistent with project needs. Aside from government-furnished equipment and specified critical WBS elements negotiated into the contract work statement, the contractor must have complete flexibility in extending WBS to show how his work is to be done, and thus complete the Contract WBS.

Configuration Management.

As a framework portraying the products and services comprising the system/project at any point in time, WBS also reflects the configuration breakdown. Through the function of configuration management, these same products are described, their physical and functional characteristics being controlled in a set of specifications and other descriptive technical documents. This composite array of specifications forms the specification tree of the system/project, which is directly related to WBS.

Another notable correlation is that all items identified in contracts as "configuration items,"[5] those subject to configuration management, are elements in the Project Summary and Contract WBSs. On the other hand, all WBS elements are not necessarily subject to configuration management. A Contract WBS, therefore, includes at least as many levels of WBS as are necessary to identify all configuration items.

Integrated Logistic Support (ILS).

In view of recently increased management attention to ILS, the WBS concept provides another mechanism by which the consideration of support requirements for system/project engineering can be assured. Accordingly, the elements needed to satisfy logistic management requirements—support equipment, facilities, repair parts, etc. —are included in the Summary WBS (Figure 1) for use in the Project Summary WBS. Below the Summary WBS levels, there may be situations in which logistics management and reporting can best be accomplished by utilizing some identifiable combination of elements related to those of the Project Summary WBS.

Procurement/Production.

The deliverable output of a contract consists of products and services, and WBS elements are established in those terms. Because of this congruity, WBS can be used as a convenient means of relating the products and services of a procurement to the natural breakdown dictated by the project's systems engineering. The Project Summary WBS can be used to formulate work statements and establish the contract line items or end items. Government-furnished equipment is also directly related to the Contract WBS. The product orientation of WBS also makes it possible to relate all contractually required technical and management reports to the Project Summary and Contract WBSs. Further, this same framework can be used for monitoring contract compliance in terms of technical performance, cost and delivery schedules. In addition, the technical data packages deliverable under the contract can be related to the summary levels of the Contract WBS.

While the foregoing contractual aspects are related to WBS, a one-to-one correlation is not necessarily required. The contract negotiator may find that the best contractual arrangement and the best contract price may be obtained by combining certain WBS elements. The contract negotiator must be free to work on the basis of a contract structure that will help him achieve a contract that has favorable terms for both the Government and its contractor. However, this latitude must not be allowed to compromise the effectiveness of the contracted work, or system performance, which are the prime factors determining the system's ultimate real value to the Government. The contract line items, end items, or work-statement tasks, therefore, should be either WBS elements or some identifiable combination of WBS elements related to the Project Summary WBS.

[5] *See DOD Directive 5010.19, "Configuration Management."*

Consequently, WBS serves to integrate the work effort and procurement details. Only one WBS is established and used from the issuance of each Request for Proposal throughout the ensuing contract.

Cost and Management Information Reporting.

Since the reporting of management information is related to hardware and services, WBS again provides a natural vehicle for this reporting. Establishing these reporting requirements on the framework of WBS means that managers can use the same data that were generated in the engineering and work process. The organization of reporting requirements before the WBS approved for the project has been developed, however, is not to be construed by either Government or contractor as determining how the system or equipment is to be designed and built.

The fact that WBSs relating to various weapon and support systems represent a uniform basis for collecting cost data makes it possible to compare the cost of like weapons and equipments, and to better estimate the cost of similar future programs. The success of these cost comparisons, however, will depend largely on ability to uniformly apply accurate definitions of the scope of WBS elements. This is one objective of the WBS-element definitions established and required by MIL–STD–881.

With respect to schedule monitoring and reporting, WBS again provides a common framework which permits the use of engineering management information for business management.

WBS also provides a discrete mechanism for implementing the basic principle that all management and cost reporting must be restricted to as high a level as is practical for assuring the program's success, while retaining flexibility of operation. Only summarized data is required to monitor the contractor's progress, but relevant detail is to be available if the need arises. In WBS, this relates to the summary levels and to critical items at lower levels. Thus the contractor has complete freedom and flexibility in his own internal management, and the amount of reporting is reduced.

WBS: A Tool for Top Management

The top managers of both DOD and defense contractors need adequate continual visibility of entire projects, with timely knowledge of project performance. They also need timely data on the occurrence of problems and the cause of these problems. In fact, what is needed is a means for detecting or predicting these problems much earlier than it has been done in the past.

In WBS, management visibility and data reporting are established in a fashion which is directly related to the systems engineering and the manner in which is the work is to be accomplished. Accordingly, WBS is viewed as a necessary tool for helping to satisfy these top management needs. The payoff to this improved management approach will be the improvement of DOD's ability to achieve the operational performance and readiness it needs at the lowest possible cost.

Navy Engineers Study Undersea Windows

Naval scientists have discovered a way to increase the visibility of deep sea submersibles by improving the design of the craft's windows.

In the past, windows on submersibles have been very small because of the lack of knowledge about the resistance of various transparent materials to pressure and the effects of window shape.

Tests at the Naval Civil Engineering Laboratory, Port Hueneme, Calif., however, reveal that windows can be greatly enlarged and retain their strength if made of acrylic plastic and constructed in a curved shape.

Curved acrylic plastic windows have been subjected to simulated dives of five minutes duration at pressures equal to those at an ocean depth of 3,400 feet and have given no evidence of failure.

The largest window tested to date measured 38 inches in diameter and four inches thick.

Test of the new window design are being conducted in the laboratory's hydrostatic pressure vessel which simulates various ocean depths by having seawater pumped in from the nearby ocean to build up pressures.

AF Develops Mobile Electronic Aircraft Scale

Aircraft weighing operations in forward combat areas in Southeast Asia have been greatly eased by the use of a new mobile electronic weighing system (MEWS).

Developed by Air Force Systems Command's Aeronautical Systems Division, at Wright-Patterson AFB, Ohio, the new system now makes it possible for aircraft to be weighed outdoors on a ramp surface on platform scales instead of the customary jacking operations inside a hangar.

The units first were used at Tan Son Nhut, Cam Ranh Bay and Da Nang air bases, according to project engineer Joseph D. Hooker, who accompanied the ground support equipment to Vietnam along with project manager, Captain V. T. Kelty Jr.

The system weighs 6,000 pounds and is mounted on a four-wheeled trailer. Each system includes eight portable electronic platform scales, 12 vehicle ramps, eight aircraft ramps and spacers for tandem axles for vehicle and aircraft.

Also included is a 24-foot specially-designed conveyor section capable of supporting single, double, or triple palletized loads of 10,000 pounds per pallet, or 30,000 pounds per triple palletized cargo loads.

MEWS also includes an electronic computing and indicating instrument which enables cargo handlers to compute automatically, for the first time, the center of gravity for multiple pallet loads.

Army Engineers Seek Improved Landing Mats

U.S. Army Engineers have launched a new research and development program to provide lighter, stronger and more economical prefabricated airfield landing mats for light, medium and heavy duty use.

Contracts are being negotiated with several firms to provide mats in each of three classifications for engineer traffic tests to be performed using aircraft wheel loads.

The Army will evaluate several new design concepts, including a nonmetallic mat and an aluminum mat with an extruded foam core.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Brig. Gen, Frank K. Everest Jr., USAF, has been named Asst. Dir. (Operational Test & Evalution), Office of the Dir. of Defense Research & Engineering.

Col. George A. Zacharias, USA, is the new Chief of the Office of Industrial Security, Defense Contract Administration Services, Defense Supply Agency.

DEPARTMENT OF THE ARMY

Maj. Gen. Leo H. Schweiter has succeeded Maj. Gen. William A. Becker as Dep. Commanding General, Army Combat Developments Command, Fort Belvoir, Va. Gen. Becker will serve as the Army's new Chief of Legislative Liaison. Maj. Gen. Osmund A. Leahy will take over as Acting Dep. Commanding General and Chief of Staff until Gen. Schweiter reports aboard. Gen. Leahy will then take command of the Institute of Land Combat, Fort Belvoir, Va. Brig. Gen. Robert E. Conner will serve as the new Chief of Staff, Combat Developments Command.

Col. Nicholas G. Bottiglieri has reported for duty as Commanding Officer and Director, Army Medical Research Unit-Presidio, and Chief, Dept. of Research & Development, Letterman General Hospital, San Francisco, Calif.

Col. William Mulheron Jr. has taken command of the Army Arsenal at Watervliet, N.Y., the Army's heavy weapons design and development center.

Lt. Col. Peter E. Hexner has succeeded Col. Leslie G. Callahan Jr., as Commander, Harry Diamond Laboratories, Washington, D.C.

Lt .Col. Edward M. Ridlehoover has been named Chief of the Army Missile Command's Future Missile Systems Div., at Redstone Arsenal, Ala.

DEPARTMENT OF THE NAVY

Capt. H.E. Nichols, SC, is the new Supply Officer at the Naval Air Engineering Center, Philadelphia, Pa. He comes to the new post from duty as Staff Supply Officer for Commander, Military Sea Transportation Service, Atlantic, headquartered in Brooklyn, N.Y.

DEPARTMENT OF THE AIR FORCE

Dr. Hans-Georg Clamann has been selected to succeed Dr. Hubertus Strughold as the Chief Scientiest of the Aerospace Medical Div., Air Force Systems Command, headquartered at Brooks AFB, Tex. Dr. Strughold has retired after more than 21 years work in aerospace medicine with the U.S. Air Force.

Dr. Stephen W. Tsai has been named Chief Scientist of the Air Force Materials Laboratory, Wright-Patterson AFB, Ohio.

The Air Force Systems Command (AFSC) has also made the following assignments of key positions:

Col. Waldo E. Bertoni, Dep. Systems Program Dir., Sentinel Foam, Electronic Systems Div., L.G. Hanscom Field, Mass.; Col. James S. Carson, Chief, Air Force Weapons Effectiveness Test Div., Armament Development and Test Center, Elgin AFB Fla., Col. Howard M. Estes Jr., Commander/Dir., Air Force Rocket Propulsion Laboratory, Edwards AFB, Calif.

Other changes at AFSC include:

Col. Charles A. Laustrup, Chief, Air Force Contracts Management Office for the Space & Missile Systems Organizat'on, Los Angeles, Calif.; Col. Joseph F. Marling, Dir., Combat Systems Program Office, Aeronautical Systems Div., Wright-Patterson AFB, Ohio; Col. Clement K. Miller, Vice Commander, Arnold Engineering Development Center, Tenn.; Col. Tipton P. Mott-Smith, Dep Dir., Aerospace Propulsion Laboratory, Wright-Patterson AFB, Ohio; Col. Donald G. Nunn, Chief of Staff, Space & Missile Systems Organization, Los Angeles, Calif.; Col. Henry A. Orban, Asst. Dep. for Subsystems & Equipment Management, Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

Additional AFSC assignments include:

Col. William Reed, Dep. Commander, Air Force Armament Laboratory, Eglin AFB, Fla.; Col. James F. Sullivan, Dir., Systems Analysis, MOL Program, Space & Missile Systems Organization, Los Angeles, Calif., Col. Durwood B. Williams, System Program Dir., 496L/474N, Electronic Systems Div., L.G. Hanscom Field, Mass.; Lt. Col. Norman J. Glenn, Asst. Chief, Flight Operations Div., Directorate of Flight Test, Aeronautical Systems Div., Wright-Patterson AFB, Ohio; and Lt. Col. Robert L. Makinney, Dir., Light Intra-theater Transport Aircraft System Program Office, Aeronautical Systems Div. Wright-Patterson AFB, Ohio.

MTMTS Centralizes Control of Personal Property Moving

Control of worldwide traffic management responsibility for the Defense Department Personal Property Moving and Storage Program has been centralized by the Military Traffic Management and Terminal Service (MTMTS).

Under the realignment, all MTMTS personal property traffic management elements will be placed under the direct supervision and control of Colonel Joseph J. Kennedy, USAF, Director of Personal Property at MTMTS headquarters in Washington, D.C.

Personal property directorates at the MTMTS Eastern and Western Area headquarters will be redesignated the MTMTS Eastern and Western Personal Property Operations Offices and will remain at their present locations in Brooklyn, N.Y., and Oakland, Calif., respectively.

MEETINGS AND SYMPOSIA

FEBRUARY

Biennial Navy League Seapower Symposium and Sea-Air-Space Exposition, Feb. 25–27, at the Sheraton Park Hotel, Washington, D. C. Sponsor: Navy League of the United States and D. C. Council of the Navy League. Contact: Dale Shear, Navy League of the United States, 808 18th St., N. W., Washington, D.C. 20006, Phone (202) 298-9282.

MARCH

Variety in Ship Engineering Technical Symposium, March 28, at the Statler Hilton Hotel, Washington, D.C. Sponsor: Association of Senior Engineers of the Naval Ship Systems Command. Contact: Mr. Jon R. Buck, Association of Senior Engineers, Naval Ship Engineering Center, SEC 6162, Room 4646, Main Navy, Washington, D.C. 20360, Phone (202) OXford 6-5550.

APRIL

International Symposium on Global Problems in Analysis, April 2–4, at Princeton University, Princeton, N.J. Sponsor: Air Force Office of Aerospace Research. Contract: Dr. R. G. Pohrer, Air Force Office of Scientific Research, (SRMM), 1400 Wilson Blvd., Arlington, Va. 22209, Phone (202) OXford 4-5264.

Mathematical Aspects of Electrical Network Analysis Symposium, April 2–5, in New York N.Y. Sponsors: Army Research Office—Durham, Air Force Office of Scientific Research, the American Mathematical Society and the Society for Industrial and Applied Mathematics. Contact: Dr. Gene Parrish, Mathematics Div., Army Research Office—Durham, Box CM, Duke Station, Durham, N.C. 27706, Phone (919) 286-2285 or Maj. Paul J. Daily, Air Force Office of Scientific Research, (SRMA), 1400 Wilson Blvd., Arlington Va. 22209, Phone (202) OXford 4-5261.

Computer Processing in Communications Symposium, April 8–10, at the Waldorf-Astoria Hotel, New York, N.Y. Sponsors: Air Force Office of Scientific Research, Office of Naval Research and the Army Research Office. Contact: Lt. Col. Robert B. Kalisch, Air Force Office of Scientific Research, (SREE), 1400 Wilson Blvd., Arlington Va. 22209, Phone (202) OXford 4-5518.

Annual National Telemetering Conference and Exposition, April 22–24, at the Washington Hilton Hotel, Washington, D. C. Sponsor: Institute of Electrical and Electronics Engineers Group on Aerospace and Electronic Systems, and Communication Technology. Contact: Robert D. Briskman, General Chairman, COMSAT, 950 L'Enfant Plaza South, S. W., Washington, D. C. 20024, Phone (202) 554-6097.

Army Numerical Analysis Conference, April 24–25, at Walter Reed Army Institute of Research, Washington, D.C. Sponsor: Army Research Office—Durham. Contact: Dr. Francis G. Dressel, Mathematics Div., Army Research Office—Durham, Box CM, Duke Station, Durham, N.C. 27706, Phone (919) 286-2285.

MAY

Twenty-Third Annual Frequency Control Symposium, May 6–8, at Atlantic City, N.J. Sponsor: Solid State and Frequency Control Division of the Electronics Components Laboratory, Army Electronics Command. Contact: Dir., Electronic Components Laboratory, Attn: AMSEL–KL–DT (Mr. M. F. Timm), Electronic Components Laboratory, Army Electronics Command, Fort Monmouth, N.J. 07703, Phone (201) 535-2250.

Biological Research in Malaria Panel Workshop, May 14-16, at the Walter Reed Army Institute of Research, Washington, D.C. Sponsor: Surgeon General, Department of the Army. Contact: Dr. Elvio H. Sadun, Chief, Department of Medical Zoology, Walter Reed Army Institute of Research, Washington, D.C. 20012, Phone (202) 198-3308.

Twenty-third Annual Power Sources Conference, May 20–22, at the Shelburne Hotel, Atlantic City, N.J. Co-sponsors: Army Electronics Command and the Interagency Advanced Power Group. Contact: Galen R. Frysinger, Chief, Power Sources Div., Army Electronics Command, Attn: AMSEL–KL–P, Fort Monmouth, N.J. 07703.

Anopheline Biology and Malaria Eradication Meeting, May 21–23, at Washington, D.C.Co-sponsors: Defense Department Armed Forces Pest Control Board and the Forest Glen Section of the Walter Reed Army Medical Center, Contact: Dr. Ronald A. Ward, Asst. Chief, Dept. of Entomology, Div. of Communicable Diseases and Immunization, Walter Reed Army Institute of Research, Room 121, Washington, D.C. 20315, Phone (202) 576-3719.

Navy Studies Submersibles for Ocean Floor Surveys

Surveys of the ocean floor, much of which has yet to be recorded on marine charts, may be conducted in the future by deep diving vehicles instead of by surface ships according to the U.S. Naval Oceanographic Office.

For the past two years, Navy scientists have been testing various manned submersibles, hoping to design a deep diving vehicle that can be used exclusively for surveying tasks.

Those included in the study were the Alvin, Star III, Deepstar–4000, Cubmarine and Aluminaut.

According to Frank Busby, the chief sceintist studying deep-diving vehicles for the Oceanographic Office, all five submersibles used in the study performed adequately.

In testing the Aluminaut it was found that data obtained by the submersible was more accurate than that gathered by surface survey ships charting the ocean floor.

Air Force Officers Learn in Industrial Jobs

Lieutenant Colonel Frank S. Raggio, USAF

Weapon system development, today, requires extremely close working relationships between military and civilian members of the defense-industry team. The military member must be as knowledgeable about research, development, procurement and production as his industry counterpart.

This need for knowledgeable military officers inspired revitalization of a post-World War II program, then called Training With Industry. As originally conceived, the training was intended to indoctrinate senior Air Force officers (lieutenant colonels and colonels) with a working knowledge of high level management techniques used by major defense industries. No formal course was followed. Instead, the Air Force officers spent their time with senior line and staff executives as they performed their daily tasks. Over the years, there has been little change from this overall concept.

In the current program, now called Education with Industry to emphasize its academic features, 150 to 170 officers, in the middle management levels (lieutenant through lieutenant colonel), are assigned to work with defense contractors for a period of 10 months. The officers may choose among 14 subject areas:

- Advanced photographic technology.
- Armament development.
- Astronautics and space vehicles.
- Automated data communications.
- Civil engineering design.
- Civil engineering construction.
- Civil engineering industrial maintenance.
- Civil engineering, astronautics and space vehicles facilities.
- Industrial planning and procurement.
- Management engineering.
- Management of research.
- Medical industrial planning and procurement.
- Missile range technology.
- Academic administration internship.

Within the 14 subjects, primary areas of study include engineering, manufacturing, operations, personnel, research and development, and sales (especially military). The major emphasis, however, is on management.

When American defense industry provides such a development opportunity, the Air Force Institute of Technology (AFIT), which administers the program, must insure that only the most qualified officers with the greatest potential are nominated to participate. As in all AFIT programs, an interested officer must apply for Education with Industry through education channels. If an officer meets certain necessary qualifications, he is issued a letter of eligibility. Screening, selection and assignment are the next steps, based upon Air Force-wide requirements. Each officer's record is screened by a special board established by Air Force headquarters and Air University, the command which supervises AFIT. The officer must have earned effectiveness performance ratings in the top levels, and must have attained sufficient levels of education. Finally, the company reviews each nominee's record, and accepts or rejects the officer.

Education with Industry programs are intended to improve the officer's career potential, but are not designed with only the next assignment in mind. Rather, the experience is aimed at long-range career development. AFIT intends that each course approximate a company management development program, which the Air Force expects will produce better military resource managers. The whole 10-month program gives each officer a level of knowledge which would normally require many years of employment to obtain.

Each company participating in the Education with Industry program appoints an employee as coordinator. He is the vital link who makes the program a dynamic management and technical learning experience. He establishes the company's program. He guides the officer-students through a broad spectrum of industrial experiences.

Many industry coordinators, drawing upon their experiences in developing industrial training programs, strongly insisted upon receiving specific program information about objectives, progress check points and curricula. AFIT, however, decided that objectives must remain general, that each company program must be as unique as the company. The company coordinator has the freedom to establish a "company" oriented program unencumbered by Air Force dictates.

The overall objective of the Education with Industry program is:

> To develop management qualities and technical leadership abilities in select officers and to provide them with industrial comprehension, and knowledge of methods used in research, development, manufacture, and procurement of Air Force hardware.

The enthusiastic support and cooperation of the participating companies, from top managers to front line supervisors, has helped the Air Force achieve this goal.

About the Author—

Lieutenant Colonel Frank S. Raggio, USAF, is Chief, Continuing Education and Evaluation Division, Air Force Institute of Technology. He has been assigned in the comptroller field and as Professor of Aerospace Studies, Montana State University. He holds a Master of Business Administration degree from The George Washington University.

Army Studies M551 Vehicle for New Light Armor Battalions

Employment of the new Sheridan Armored Reconnaissance/Airborne Assault Vehicle (M551) by a light armor battalion is being studied by the Army during extensive field tests at Fort Riley, Kan., and Fort Gordon, Ga.

Main purpose of the troop tests, being sponsored by the Army Combat Developments Command (CDC), Fort Belvoir, Va., is to evaluate doctrinal and organizational use of the M551 by a light armor battalion.

The entire package—equipment, doctrine and organization, working interdependently—is the light armor battalion concept. It is expected to be a weapon system that will fully exploit the capabilities of the lightweight (16.5-ton) Sheridan vehicle.

Data on firepower and maintenance of the Sheridan vehicle will shape CDC's final specifications for the new light armor battalion.

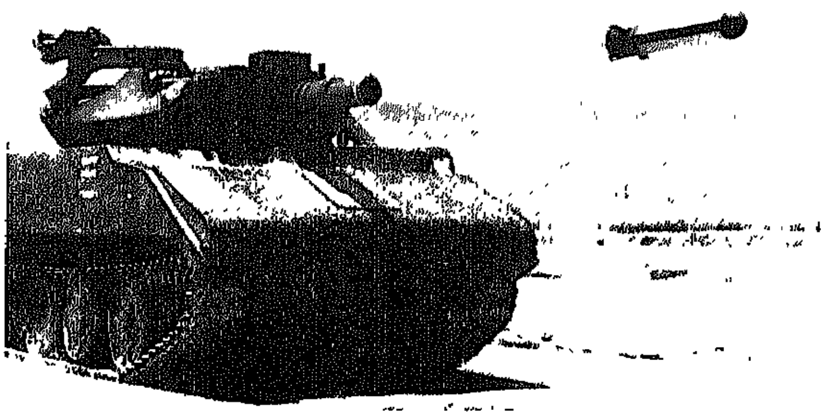
The M551 is equipped with the Shillelagh missile as well as its own long range anti-tank knockout punch. During the troop tests, the Sheridan's conventional, but unique, round with the combustible casing is also being studied to determine the effectiveness of the ammunition's weather proofing and safety devices.

A bore Scavenging System, which uses a compressed air blast to flush residue from the firing tube, is another new system which is being evaluated. A compressor kicks in after a couple of rounds have been fired to recharge the compressed air containers.

The platoon firing exercises use stationary and moving targets, engaged by conventional ammunition and the Shillelagh guided missile, both from the M551's 152mm tube. The vehicle's .50 caliber and 7.62mm machine guns also are getting a work-out.

In addition, the Sheridan's various night vision devices (infrared, searchlight and Starlight Scope) are being looked at carefully in night run-throughs. The Starlight Scope is an image-intensifier using existing natural light and has the advantage of being undetectable by enemy troops.

The tests are being directed by Brigadier General Linton S. Boatwright, Commanding General of Fort Riley and of the 24th Infantry Division. Closely supervising the tests is Colonel George E. Kimball, Deputy Test Director, called in especially from the Armor School, Fort Knox, Ky., for the CDC troop test.



SHERIDAN ARMORED ASSAULT vehicle fires a Shillelagh missile from its gun during employment evaluation.

AF Tests New Thermoelectric Air Conditioners

The Air Force is testing a thermoelectric air conditioner for use in mobile communications vehicles. It is 12 times more reliable than conventional compressed vapor systems.

Developed for the Air Force by Radio Corporation of America's Defense Electronic Products Division, Camden, N.J., the new air conditioners have an estimated time before failure of 6,000 hours, against 480 for vapor units.

Thermoelectric air conditioners operate by passing an electric current through a semiconductor alloy composed of bismuth and tellurium. The electricity results in heat absorption or cooling on one side and heat radiation on the other. When the polarity on the thermoelectric circuit is reversed, the unit acts as a heater.

Officials at the Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio, which is managing the project, say that a single unit is capable of cooling a four-room apartment to 15 degrees below the outside temperature.

The modules and fans used in the prototype can be applied to any thermoelectric air conditioner, thus enabling the Air Force to develop a family of the units.

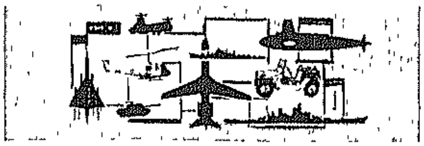
The present prototype is about 15 cubic feet in size and weighs 300 pounds.

Coast Guard Opens R&D Office

The U.S. Coast Guard has established an Office of Research and Development to meet future requirements in marine science, search and rescue, aids to navigation and marine safety.

Rear Admiral Orvan R. Smeder has been named chief of the new organization and Dr. Charles C. Bates has been designated as the deputy chief, as well as chief scientist of the Coast Guard.

Located at U.S. Coast Guard headquarters, 1300 E St., N.W., Washington, D.C., the new office is organized into three divisions: the Applied Sciences Division, the Applied Technology Division, and the Human Resources Division.



DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of December 1968.

DEFENSE SUPPLY AGENCY

2—Burley Processing, Burley, Idaho. $1,711,286. 461,584 cases of sliced, uncooked dehydrated potatoes. Defense Personnel Support Center, Philadelphia, Pa DSA 137-69-C-CB59.

4—Lester D. Lawson & Co., Long Beach, Calif. $1,699,891. 57,120 cases of sundries packs for ration supplements. Defense Personnel Support Center, Philadelphia, Pa DSA 134-69-C-0480.

5—Ojus Industries, Miami, Fla. $1,729,354. 200,004 coils of concertina barbed wire Defense Construction Supply Center, Columbus, Ohio. DSA 700-69-C-1066

—Columbian Steel Tank Co., Kansas City, Mo $1,970,048. 105 liquid storage tanks. Defense Construction Supply Center, Columbus, Ohio. DSA 700-69-C-0946.

11—Gulf Oil Corp., Houston, Tex $5,580,921. 23,802,000 gallons of gasoline; 2,932,500 gallons of diesel fuel and 53,455,100 gallons of fuel oil Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0727.

13—E. I. DuPont DeNemours & Co., Wilmington, Del. $2,649,390. 65,626,200 lbs. of amonium nitrate Defense General Supply Center, Richmond, Va. DSA 400-69-C-3318.

—Phillips Scientific Corp., Bartlesville, Okla. $2,094,998. 56,698,200 lbs. of amonium nitrate. Defense General Supply Center, Richmond, Va. DSA 400-69C-3322.

16—Pembroke, Inc., Egg Harbor City, N.J. $1,551,788. 71,610 men's blue serge overcoats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1037.

20—GAF Corp., New York, N.Y. $1,089,189. 19,900 rolls of photographic aerial film. Defense General Supply Center, Richmond, Va DSA 400-69-C-3452.

27—M.L.W. Corp., Bapamon, Puerto Rico, $2,450,000. 1,000,000 pairs of men's wind-resistant sateen ripstop poplin trousers Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1107.

DEPARTMENT OF THE ARMY

2—Chamberlain Mfg Corp., Elmhurst, Ill. $1,853,747 (contract modification). Metal parts for 4.2-inch projectiles. Waterloo, Iowa. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-68-C-0036

—Philco-Ford Corp., Newport Beach, Calif $1,380,000. Classified countermeasure program Army Missile Command, Huntsville, Ala. DA AH01-69-C-0878.

3—Jones & Laughlin Steel Corp., Pittsburgh, Pa. $2,470,121 Electric steel welded pipe. Engineer Dist., San Francisco, Calif. DA CA09-69-C-0020.

—Cadillac Gage Co., Warren, Mich. $1,410,000. Light armored cars Tank Automotive Command, Warren, Mich. DA AE07-69-C-0744.

—Hughes Tool Co., Culver City, Calif. $1,194,380. OH-6A helicopter hub assemblies Aviation Materiel Command, St. Louis, Mo DA 23-204-AMC-03697.

4—Institute for Defense Analyses, Arlington, Va $5,300,000 (contract modification). Basic and applied research; $3,300,000 (contract modification). Evaluation and operational analyses. Defense Supply Service, Washington, D.C. DA HC15-67-0011 DA HC15-67-C-0012.

—Baldwin Electronics, Inc., Little Rock, Ark. $3,101,760. Loading, assembling and packing 2.75-inch rocket motors. Camden Ark. Picatinny Arsenal, Dover, N.J. DA AA21-69-C-0317.

—John R. Hollingsworth Co., Phoenixville, Pa $2,071,026 (contract increment). Generator sets Mobility quipment Command, St. Louis, Mo. DA AK01-68-C-1572.

—Pace Corp., Memphis, Tenn. $1,193,550. Ground-to-air parachute flares. Memphis and Camden, Ark. Picatinny Arsenal, Dover, N.J. DA AA21-69-C-0284.

—General Electric, Burlington, Vt. $1,009,281 Spare parts for the 20mm vulcan gun. Army Procurement Agency New York, N.Y. DA AG25-69-C-0347

5—Bell Aerospace Corp., Fort Worth, Tex $2,425,000. HH-1K search and rescue helicopters. Hurst, Tex. Aviation Materiel Command, St. Louis, Mo. DA AJ01-68-C-1011.

—General Motors, Cleveland, Ohio $1,000,000. Interim phase of advanced production engineering on the XM-70 combat tank. Cleveland and Milwaukee, Wis. Tank Automotive Command, Warren, Mich. DA AE07-69-C-0770.

6—Caterpillar Tractor Co., Peoria, Ill. $2,396,817. Tractors and repair parts. Army Missile Command, Huntsville. Ala. DA AK01-69-C-4706.

—Greenhut Construction Co., Pensacola, Fla. $1,357,756. Construction of officers quarters at Columbus AFB, Miss. Engineer Dist., Mobile, Ala. DA CA01-69-C-0002.

—Western Electric, New York, N.Y. $1,189,350 (contract modification). Modification and rehabilitation of a government-owned facility at Burlington, N.C., in support of the Sentinel production program Sentinel System Command, Huntsville, Ala. DA HC60-68-C-0026

—General Motors, Pontiac, Mich. $3,425,349. Trucks with repair parts and technical manuals. Mobility Equipment Command, St. Louis, Mo. DA AK01-69-C-4945.

—Iowa Mfg. Co., Cedar Rapids, Iowa. $2,091,292. Crushing and screening plants for use on highway restoration. Mobility Equipment Command, St. Louis, Mo. DA AK01-69-C-4660.

—International Harvester Co., Melrose Park, Ill. $1,500,000. Loaders. Libertyville, Ill. Mobility Equipment Command, St. Louis, Mo. DA AK01-69-C-4674.

9—AVCO Corp., Stratford, Conn. $2,232,810 (contract modification). T55-L-11 turbine engines for CH-47C helicopters. Aviation Materiel Command, St. Louis, Mo. DA AJ01-68-C-1858.

—Western Electric, New York, N.Y. $3,242,291 (contract modification). Sentinel training aids and engineering. Greensboro, N.C.; Bedford, Mass.; Syracuse, N.Y.; and Santa Monica, Calif. Sentinel Systems Command, Huntsville, Ala. DA HC60-69-C-0010.

—Kennedy Van Saun Corp., Danville, Pa. $3,858,140. Metal parts for 105mm projectiles Ammunition Procurement & Supply Agency, Joliet, Ill DA AA09-69-C-0257.

—Philco-Ford Corp., Philadelphia, Pa. $4,156,115 (contract modification). Installation and testing of a classified equipment for a world-wide communication system. Electronics Command, Fort Monmouth, N.J. DA AB08-67-C-0153.

10—Kaiser Steel Corp., El Monte, Calif. $3,274,000. Boxes for small caliber ammunition. Culver City, Calif Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0186.

11—Pace Corp., Memphis, Tenn. $1,917,168. White Star parachute signals. Picatinny Arsenal, Dover, N.J DA AA21-69-C-0327.

12—FMC Corp., San Jose, Calif. $1,850,000. M113A1 full-tracked personnel carriers. Tank Automotive Command, Warren, Mich. DA AE07-69-C-0762.

—Gould Marathon Battery Co., St. Paul, Minn. $2,014,000. Dry batteries. Electronics Command, Philadelphia, Pa. DA AB05-69-C-3223.

—Union Carbide Corp., New York, N.Y. $1,836,240. Dry batteries. Electronics Command, Philadelphia, Pa. DA AB05-69-C-3224

—Radio Engineering Labs, Long Island City, N.Y. $2,200,000 (contract modification). Ten shelters for use with the Integrated Wide Band Communications System. Electronics Command, Fort Monmouth, N.J. DA AB07-68-C-0424.

13—Honeywell, Inc., Tampa, Fla. $2,000,000 (contract modification). Classified electronic repair parts Electronics Command Fort Monmouth, N.J. (contract number is classified).

—Hercules, Inc., Wilmington, Del. $1,350,000. 1,000,000 lbs. of M9 propellant for 81mm mortars. Kenvil, N.J. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0280.

—Mason & Hanger, Silas Mason Co., New York, N.Y. $5,934,750 (contract modification). Support services and for loading assembling and packing ammunition and components. Burlington, Iowa. Ammunition Procurement & Supply Agency Joliet, Ill. DA AA09-68-C-0408.

—Goodyear Tire & Rubber, Co., Akron Ohio. $1,131,488. Pneumatic tires for 2½ and 5-ton trucks. Gadsden, Ala. Tank Automotive Command, Warren, Mich. DA AE07-69-C-1273.

—Lockheed Aircraft, Sunnyvale, Calif. $2,177,150 (contract modification). A classified quantity of YO-3A aircraft. Aviation Materiel Command, St. Louis, Mo DA AJ01-69-C-0050.

—Chrysler Corp., Warren, Mich. $11,065,017 (contract modification). M60A1 combat tanks. Army Weapons Command, Rock Island, Ill. DA AF03-69-C-0018.

—Charles N. Bohrer, Atlanta, Ga. $1,670,63[illegible] Construction of a water treatment plant at Fort Gordon, Ga. Engineer Dist., Savannah, Ga. DA CA21-69-C-0028.

—Martin-Marietta Corp., Orlando, Fla $1,739,075. Special test program for the Pershing weapon system. Army Missile Command, Huntsville, Ala. DA AH01-69-C-0863.

—Hughes Aircraft, Culver City, Calif. $2,578,500 (contract modification). Laser range finders for M60-A1E2 tanks. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0153.

16—Lear Siegler, Inc., Anaheim, Calif. $7,805,375. Metal parts for 105mm artillery shell fuzes. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-1069.

—Gibbs Mfg. & Research Corp., Janesville, Wis. $1,985,400. Metal parts for 2.75-inch rocket fuzes. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0104.

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company — Value — Material or Work to be Performed—Location of Work Performed (if other than company plant) — Contracting Agency—Contract Number.

17—**Chrysler Motors**, Warren, Mich. $5,535,101 Cargo trucks and ambulances. Tank Automotive Command, Warren, Mich. DA AA07-69-C-0771.

18—**Honeywell, Inc.**, Tampa, Fla. $15,500,000. Classified electronic equipment. Electronics Command, Fort Monmouth, N.J.

—**General Motors**, Oak Creek, Wis. $2,500,000. Integration of night sights into an armored vehicle. Mobility Equipment Command, Fort Belvoir, Va. DA AK02-69-C-0156.

—**Hughes Aircraft**, Fullerton, Calif. $1,172,995 (contract modification). A 12-month engineering program for the AN/TSQ-51 air defense control and coordination system. Army Missile Command, Huntsville, Ala. DA 01-021-AMC-15606.

19—**Harrington & Richardson, Inc.**, Worcester, Mass. $11,835,842 M16A1 rifles and for inspection and test equipment Army Weapons Command, Rock Island, Ill DA AF-03-68-C-0045.

—**General Motors**, Ypsilanti, Mich. $9,459,600. M16A1 rifles and for inspection and test equipment. Army Weapons Command, Rock Island, Ill. DA AF-03-68-C-0046.

—**American Machine & Foundry Co.**, York, Pa. $13,980,000. Metal parts for 105mm high explosive projectiles. $1,438,636. Provision of facilities for the manufacture of metal parts for 105mm high explosives. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0267. DA AA09-69-C-0270.

20—**Raytheon Co.**, Andover, Mass. $1,083,507. Repair of radar sets for the HAWK missile system. Fort Bliss, Tex. Army Missile Command, Huntsville, Ala. DA AH01-68-A-0087.

—**International Terminal Operating Co.**, New York, N.Y. $13,976,526. Stevedoring and related terminal services for a two-year period at the Military Ocean Terminal, Bayonne, N.J. Military Traffic Management & Terminal Service, Brooklyn, N.Y. DA HC21-69-D-0080.

—**Harvey Aluminum Co.**, Torrance, Calif. $7,089,397 (contract modification). Loading, assembling and packaging ammunition and components, and for maintenance and support services at the Army Ammunition Plant, Milan, Tenn. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00520 (A).

—**Kaiser Jeep Corp.**, Toledo, Ohio. $7,332,287 (contract modification). Five-ton trucks (M39 series). South Bend, Ind. General Purpose Vehicle Project Manager, Army Missile Plant, Warren, Mich. DA AE06-69-C-0012.

—**Mack Trucks**, Allentown, Pa. $4,651,606 (contract modification). Diesel engines for 5-ton trucks. Hagerstown, Md. General Purpose Vehicle Project Manager, Army Missile Plant, Warren, Mich. DA AE06-68-C-0010.

—**Boeing Co.**, Morton, Pa. $1,244,553. Transmission assemblies for CH-47 helicopters. Aviation Systems Command, St. Louis, Mo. DA AJ01-68-A-0005.

—**Bell Helicopter Co.**, Fort Worth, Tex. $1,007,400. Modification kits for the XM35 weapon systems for the AH-1G helicopter. $1,753,005. Blade assemblies for UH-1 helicopters. Aviation Systems Command, St. Louis, Mo. DA ADJ01-68-A-0022. DA AJ01-68-A-0022.

—**Mack Trucks**, Allentown, Pa. $1,626,562. Tractor and dump trucks, and spare part kits. Allentown, Pa. and Woodbridge, N.J. Tank Automotive Command, Warren, Mich.

23—**Olin Mathieson Chemical Corp.**, East Alton, Ill. $2,341,000 and $9,053,070. 60mm (M83A3) and 81mm (M301A2) projectiles. Marion, Ill. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0051 and DA AA09-69-C-0086.

—**Bell Helicopter Co.**, Fort Worth, Tex. $9,079,095. Rotary wing blades for UH1 helicopters. Aviation Materiel Command, St. Louis, Mo. DA AJ01-68-A-0022.

—**Honeywell, Inc.**, North Hopkins, Minn. $1,951,254. M219E1 fuzes for bomblets. St. Louis Park, Minn. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0140.

—**Goodyear Tire & Rubber Co.**, Akron, Ohio. $2,217,048. Pneumatic tires for 2½-ton trucks. Gadsden, Ala. and Danville, Va. Tank Automotive Command, Warren, Mich. DA AE08-69-C-1820.

—**B.F. Goodrich Co.**, Akron, Ohio. $1,051,881. Pneumatic tires for 2½-ton trucks. Miami, Okla. Tank Automotive Command, Warren, Mich DA AE07-69-C-1821.

24—**Raytheon Co.**, Andover, Mass. $2,394,000. Rebuilding of high power illuminators for the Hawk missile system Roedelheim, Germany Army Missile Command, Huntsville, Ala. DA 01-021-AMC-14159 (Z).

—**Heckethorn Mfg. Co.**, Dyersburg, Tenn. $1,017,045 (contract modification). Hand grenades. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0127.

—**Philco Ford Corp.**, Philadelphia, Pa. $4,500,000 Classified electronic equipment. Electronics Command, Fort Monmouth, N.J.

—**Bell Helicopter Co.**, Fort Worth, Tex. $5,338,041 Rotary wings for UH-1 helicopters Aviation Systems Command, St. Louis, Mo DA AJ01-68-A-0222.

—**LTV Electro-Systems, Inc.**, Huntington, Ind. $8,084,062. Radio sets Huntington Ind. and Salt Lake City, Utah. Electronics Command, Philadelphia, Pa. DA AB05-69-C-1320.

—**Emerson Electric Co.**, St. Louis, Mo. $1,736,250. XM-28 helicopter armament subsystems. Army Weapons Command Rock Island, Ill. DA AF03-68-C-0025.

26—**Western Electric**, New York, N.Y. $18,273,907 (contract modification). Production of training aid devices for Sentinel. Burlington, N.C. Sentinel System Command, Huntsville, Ala DA HC60-68-C-0017.

—**General Time Corp.**, LaSalle, Ill. $9,911,714. Metal parts for multi-purpose fuzes. Peru, Ill Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0310.

—**Harvey Aluminum**. Torrance, Calif. $3,113,415. 40mm cartridge cases. Army Procurement Agency, Pasadena, Calif. DA AA09-69-C-0143.

—**Zenith Radio Corp.**, Chicago, Ill $2,482,022. 66mm rocket fuzes. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0039.

—**Hayes-Albion Corp.**, Albion, Mich. $1,508,580. Metal parts for 2.75-inch rocket warheads. Hillsdale, Mich Army Procurement Agency, Cincinnatti, Ohio. DA AA09-69-C-0128.

—**General Motors**, Indianapolis, Ind. $1,313,850. Transmission components for the M109 tracked combat vehicle. Tank Automotive Command, Warren, Mich. DA AE07-68-C-0836.

27—**Honeywell, Inc.**, Tampa, Fla. $7,806,387. Multiplexers and related spare parts kits. Electronics Command, Philadelphia, Pa. DA AB05-67-C-1225.

—**R.C.A.**, Burlington, Mass. $6,127,070. Land combat support system sets. Army Missile Command, Huntsville, Ala. DA AH01-69-C-0775.

—**General Electric**, Burlington, Vt. $3,000,000. M61A1 20mm guns, GAU-4/A 20mm guns and SUU-23/A pods. Procurement Agency, New York, N.Y. DA AG25-68-C-0864.

—**Flinchbaugh Products**, Red Lion, Pa. $2,790,006. Metal parts for 152mm projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0317.

—**Airport Machining Corp.**, Martin, Tenn. $1,687,125. 60mm projectiles. Union City, Tenn. Army Procurement Agency, Cincinnati, Ohio. DA AA09-69-C-0064.

—**General Electric**, Burlington, Vt. $1,616,826. Line items of repair parts for the 20mm XM35 armament sub-system. Army Weapons Command, Rock Island, Ill. DA AF03-69-C-0036.

—**Radiation, Inc.**, Melbourne, Fla. $1,500,000. Classified electronic equipment. Electronics Command, Fort Monmouth, N.J.

—**FMC Corp.**, Santa Clara, Calif. $1,301,272. Metal parts for 4.2-inch projectiles. Anniston, Ala. Army Procurement Agency, Chicago, Ill. DA AG11-69-C-0369.

—**Bell Aerospace Corp.**, Fort Worth, Tex. $1,249,041. Hydraulic servo cylinders for AH-1G helicopters. Hurst, Tex. Aviation Systems Command, St. Louis, Mo. DA AJ01-68-A-0022.

—**Otto J. Eickhof & Sons, Inc.**, Crookston, Minn. $1,016,007. Additions and alterations to a medical center and a dental clinic at Grand Forks AFB, N.D. Engineer Dist., Omaha, Neb. DA CA45-69-C-0037.

—**General Motors**, Detroit, Mich. $2,936,392. The development phase of a total package procurement award for design, development, advanced production engineering, confirmatory test, and production of 1¼-ton utility trucks and ambulances. Warren, Mich. and Baltimore, Md. Tank Automotive Command, Warren, Mich. DA AE07-69-C-0071.

30—**Hercules, Inc.**, Wilmington, Del. $19,589,203 (contract modification). Manufacture of propellants and explosives. Radford, Va Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00037 (A).

—**Raytheon Co.**, Lexington, Mass. $4,206,800. Metal parts for 750-lb bomb tail fuzes. $3,785,652. Metal parts or 750-lb. bomb nose fuzes. Work on both contracts will be done in Bristol, Tenn Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0073. DA AA09-69-C-0070.

—**Thiokol Chemical Corp.**, Bristol, Pa. $4,082,642 (contract modification). Load, assemble and pack ammunition and ammunition components Marshall, Tex. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-200 (A).

—**Honeywell, Inc.**, North Hopkins, Minn. $3,582,675. M219 and M219E1 bomblet fuzes. $1,330,400. Metal parts for bomb nose fuzes. Work on both contracts will be done in New Brighton, Minn. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0138. DA AA09-69-C-0106.

—**Consolidated Box Co.**, Tampa, Fla. $1,786,795. 4.2-inch mortar containers. Army Procurement Agency, Chicago, Ill. DA AG11-69-C-0399.

—**Chimera Corp.**, Kearney, Neb. $2,431,620. Generator sets. Mobility Equipment Command, St. Louis, Mo. DA AK01-69-C-4537.

—**Stevens Mfg. Co.**, Ebensburg, Pa. $2,330,532. 12-ton semi-trailers. Tank Automotive Command, Warren, Mich. DA AE07-69-C-1443.

—**Alcan Aluminum Corp.**, Riverside, Calif. $2,303,694. 66mm rocket motors. Army Procurement Agency, Pasadena, Calif. DA AA09-69-C-0107.

—**Goodyear Tire & Rubber Co.**, Akron, Ohio. $2,217,048 (contract modification). Pneumatic tires Gadsden, Ala. and Danville, Va. Tank Automotive Command, Warren, Mich. DA AE07-69-C-1820.

—**Bell Aerospace Corp.**, Fort Worth, Tex. $1,036,342. Gear box assemblies for UH-1 helicopters. Hurst, Tex. Aviation Systems Command, St. Louis, Mo. DA AJ01-68-A-0022.

—**Bauer Ordnance Co.**, Warren, Mich $1,000,537. Hydraulic rammer assemblies for M109 self-propelled howitzers and concurrent repair parts. Army Weapons Command, Rock Island, Ill. DA AF03-69-C-0044.

—**AVCO Corp.**, Stratford, Conn. $1,389,022. Repair parts for T-53 turbine helicopter engines. Aviation Systems Command, St. Louis, Mo. AF 41-608-67-A-3234.

31—**Eastman Kodak Co.**, Kingsport, Tenn. $24,699,272 (contract modification). Production of explosives and for support services. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00035 (A).

—**Sperry Rand Corp.**, New York, N.Y. $14,592,908 (contract modification). Production of ammunition and components. Shreveport, La. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00080 (A).

—**National Gypsum Co.**, Buffalo, N.Y. $12,581,522 (contract modification). Production of ammunition and related components. Parsons, Kan. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00095 (A).

—**Medico Industries**, Wilkes Barre, Pa. $4,012,800. Metal parts for 2.75-inch rocket warheads. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0319.

—**Northrop Corp.**, Anaheim, Calif. $3,435,000. Metal parts for 2.75-inch rocket warheads. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0303.

—**Lehigh, Inc.**, Easton, Pa. $3,240,760. Metal parts for 2.75-inch rocket warheads. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0300.

—**Appalachian Power Co.**, Radford, Va. $3,225,000 (contract modification). Electrical power to support production requirements at the Army Ammunition Plant, Radford, Va. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00134 (A).

—Chamberlain Mfg Corp., Elmhurst, Ill. $2,355,280. Metal parts for 105mm projectiles Waterloo, Iowa Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0320.

—General Time Corp, LaSalle, Ill. $1,662,120 Metal parts for M423 rocket fuzes Ammunition Procurement & Supply Agency, Joliet, Ill DA AA09-69-C-0105

—Western Electric, New York, N.Y $32,052,245 Design, development, fabrication, installation and testing of the common apperture multifunction array radar system Burlington and Winston Salem, N C., Wippany, N J. and Wayland, Mass Sentinel System Command, Redstone Arsenal, Ala. DA HC60-69-C-0040

—Western Electric, New York, N.Y $10,871,000 (contract modification) Additional research and development on the Sentinel Missile System, Morris Plains, N J, Huntington Beach, Calif, Bedford, Mass. and Syracuse, N.Y. Sentinel System Command, Redstone Arsenal, Ala. DA 30-069-AMC-00333 (Y).

—Western Electric, New York, N.Y $5,009,728 (contract modification) Additional hardware for the Sentinel Perimeter Acquisition Radar. Burlington, N.C, Whippany, N.J., and Syracuse, N.Y. Sentinel System Command, Redstone Arsenal, Ala. DA 30-069-AMC-00333 (Y).

—Hazeltine Corp., Little Neck, N.Y $3,506,000. Ground interrogator sets which elicit responses from airborne transponders. Greenlawn, N Y Electronics Command, Philadelphia, Pa. DA AB05-69-C-0404

—Raytheon Co., Norwood, Mass. $3,068,398. Multiplexers and spare parts kits. North Dighton, Mass. Electronics Command, Philadelphia, Pa. DA AB05-69-C-1012

—Phalo Corp., Shrewsbury, Mass. $1,115,629. Cable and adapter assemblies. Laredo, Tex. Electronics Command, Philadelphia, Pa DA AB05-69-C-1020.

—Western Electric. New York, N.Y. $6,445,150 (contract modification). FY 69 Nike Hercules missiles system engineering services. Burlington, N.C, Syracuse, N.Y and Santa Monica, Calif. Army Missile Command, Huntsville, Ala. DA AH01-68-C-0105.

—Amron-Orlando Corp., Orlando, Fla $5,677,412 Metal parts for 40mm cartridge fuzes. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0047.

—Chrysler Corp., Detroit, Mich. $5,365,896 (contract modification). Settlement of engineer orders on M60A1E2 combat tanks, combat engineering vehicles and M60A1 AVLB tanks with combat chassis Army Weapons Command, Rock Island, Ill DA AF03-67-C-0009

—Texas Instruments, Inc., Dallas, Tex. $3,500,000. Classified electronics equipment Electronics Command, Fort Monmouth, N.J.

—Chrysler Corp., Detroit, Mich. $2,377,144 (contract modification). Settlement of engineering orders on M60A1E1 turret systems and concurrent repair parts Army Weapons Command, Rock Island, Ill. DA 11-199-AMC-00662 (W)

—Action Mfg. Co., Philadelphia, Pa $1,951,196 (contract modification). Metal parts for 750-lb bomb tail fuzes. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0075.

—Cargill Detroit Corp., Clawson, Mich. $1,796,312. White phosphorus production equipment. Engineer Dist, Fort Worth, Tex. DA CA63-69-C-0079.

—Norris Industries, Los Angeles, Calif. $1,705,037 (contract modification), 152mm projectiles Army Procurement Agency, Pasadena, Calif. DA AG07-68-C-1257.

—University of Wisconsin, Madison, Wis. $1,420,000 (contract modification). Operation of the Mathematics Research Center, Madison, Wis Army Research Office, Durham, N.C. DA 31-124-ARO-D-0462.

—ITT Corp., Eaton, Pa. $1,408,645. Repair parts for image intensifier assemblies Roanoke, Va. Electronics Command, Fort Monmouth, N.J. DA AB07-68-C-0115.

—Andrews & Parrish Co., Richmond, Va. $1,244,900. Construction of active Army support facilities at A.P. Hill Military Reservation, Va. Engineer Dist., Norfolk, Va DA CA65-69-C-0028.

—General Motors, Detroit, Mich. $1,085,425. Diesel engines for 1¼-ton trucks. Tank Automotive Command, Warren, Mich. DA AE07-68-C-2507.

DEPARTMENT OF THE NAVY

2—Harvey Industries, Glendale, Calif $1,914,045 Zuni rocket launchers Navy Ships Parts Control Center, Mechanicsburg, Pa N00104-69-C-0161.

3—Magnavox Co., Fort Wayne, Ind $31,916,849 (contract modification) Airborne ASW systems Naval Air Systems Command N00019-68-C-0497.

—Pace Corp., Memphis, Tenn. $1,033,560 Detonating fuses for 5-inch, 54 cal guns Navy Ships Parts Control Center, Mechanicsburg, Pa N00104-69-C-0171.

—AVCO Corp., Stratford, Conn. $1,547,060 Constant speed drives for generators Naval Air Systems Command N00019-69-C-0082.

—General Dynamics, Groton, Conn $22,000,000 Materials and equipment for construction of a nuclear attack submarine Naval Ships Systems Command N00024-67-C-0345.

4—Grumman Aircraft Engineering Corp., Bethpage, N.Y. $10,420,000 (contract modification). Long lead time effort for FY 1969 procurement of A-6A aircraft. Naval Air Systems Command. NOw 66-0058.

—United Aircraft, Stratford, Conn $7,896,130 HH-3F helicopters for the Coast Guard. Naval Air Systems Command. N00024-69-C-0261.

—Westinghouse Electric, Pittsburgh, Pa. $4,657,400. Nuclear reactor compartment components Naval Ship Systems Command. N00024-69-C-5101.

—General Dynamics, Pomona, Calif. $3,081,790. Weapon systems modernization of seven guided missile frigates. Naval Ship Systems Command. N00024-69-C-0241.

5—Dixie Mfg. Co., Baltimore, Md. $5,797,768 Procurement of two deep dive systems to be installed aboard two new submarine rescue ships. Naval Ship Systems Command. N00024-69-C-0261

—Auchter Co., Jacksonville, Fla. $3,298,000. Construction of a patrol aircraft support facility Jacksonville, Fla. Southeast Div, Naval Facilities Engineering command, Charleston, S.C. N62467-67-C-0473

6—Todd Shipyards, New York, N.Y $13,950,000 Construction of an oceanographic research ship. Seattle, Wash. Naval Ship Systems Command. N00024-69C-0256.

—University of Washington, Seattle, Wash $2,365,500. Research and development in the field of underwater ordnance Naval Ordnance Systems Command. NOw 65-0207-d.

—Bendix Corp., Mishawaka, Ind. $1,220,000 Engineering and development program on TALOS RIM-8 series and TALOS ARM missiles and associated production and tactical test equipment. Naval Ordnance Systems Command. N00017-68-C-4302.

—Chromalloy American Corp., Edwardsville, Ill $1,024,435. Electric primers used in the 5-inch, 38-cal. gun ammunition loading program. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0144

9—Raytheon Co., Lowell, Mass. $7,350,847. Guidance and control groups for Sidewinder missiles for the Navy and Chaparral missiles for the Army Naval Air Systems Command. N00019-69-C-0200.

—Alsco, Inc., St. Louis, Mo. $5,042,549 (contract modification). Rocket launchers. Naval Air Systems Command. N00019-68-C-0562.

—Norris Industries, Los Angeles, Calif. $4,905,938 MK 81, MOD 1, bomb bodies for 250-lb. bombs. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0188.

—Cosmodyne Corp., Torrance, Calif. $2,489,500 Ammi flash distillation water barges. Naval Facilities Engineering Command N62473-69-C-0037

—Hartman Systems Co., Huntington Station, N.Y $2,171,953. Refurbishing and modifying navigational computer display sets. Naval Air Systems Command. N00019-69-C-0160.

—Fairbanks Morse, Inc., Beloit, Wis $2,008,246. Diesel engines, associated special tools, and engineering services. Naval Ship Systems Command N00024-69-C-5259.

—Lasko Metal Products, Hughestown, Pa $1,914,045. Zuni rocket launchers Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0167.

—Curtiss Wright Corp., Wood-Ridge, N J. $1,846,610. Modification kits for J65 engines used on A-4 aircraft. Aviation Supply Office, Philadelphia, Pa. F41608-69-A-0057-GB01

—General Precision Systems, Inc. Little Falls, N.J $1,038,717 Converter and mounting components for the AN/AVA-1 digital data system. Aviation Supply Office, Philadelphia, Pa. N00383-69-C-0063

10—LTV Aerospace Corp., Dallas, Tex. $7,500,000 (contact modification). Long lead time effort in support of FY 1970 procurement of A-7D aircraft $7,000,000 (contract modification). Long lead time effort in support of FY 1970 procurement of A-7E aircraft. Naval Air Systems Command N00019-67-C-0143. N00019-68-C-0075

—Sperry Rand Corp., St. Paul, Minn. $9-841,500. Avionics computers for P-3C aircraft. $3,319,081 (contract modification) Avionics computers for P-3C aircraft. Naval Air Systems Command N00019-69-C-0296. N00019-68-C-0255.

—Fairchild Hiller Corp., Syosset, N.Y. $4,-687,496. MK 344, MOD O and MK 376, MOD O, electric bomb fuzes Naval Air Systems Command. N00019-69-C-0337.

—Lockheed Aircraft, Marietta, Ga. $3,-500,000 Research and development on a classified project. Naval Air Systems Command. N00019-69-C-0309

—Honeywell, Inc., Seattle, Wash. $1,-395,310. MK 48, MOD O torpedo program management; test planning, data taking, reduction and analysis, full time test vessel service and research and development support services. Naval Ordnance Systems Command. N00017-69-C-1210.

—Schenuit Industries, Baltimore, Md. $1,-008,897. Pneumatic tires for A4 aircraft. Aviation Supply Office, Philadelphia, Pa N00383-69-C-2518.

11—General Electric, West Lynn, Mass. $2,-917,419. Retrofit kits for T58-GE-8 engines Aviation Supply Office, Philadelphia, Pa. F34601-68-A-2114-GBGY.

12—General Electric, Utica, N.Y. $3,180,968 Guidance and control groups for Chaparral missiles. Naval Air Systems Command. N00019-69-C-0199.

—DeLaval Turbine, Inc, Trenton, N.J. $1,-976,631. Steam turbine generators including associated engineering services, technical data and reports. Naval Ship Systems Command. N00024-69-C-5254.

13—A. G. Schoonmaker Co., Inc., Sausalito, Calif. $3,030,234. Production of generators. Naval Construction Battalion Center, Davisville, R I. N62578-68-C-0126.

—Hercules, Inc., Wilmington, Del. $1,-958,891. Composition D-2 wax Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0186.

16—North American Rockwell Corp., McGregor, Tex. $4,911,553. Rocket motors for Sparrow and Shrike guided missiles. Naval Air Systems Command. N00019-69-C-0215

—United Aircraft, East Hartford, Conn. $2,-250,000 (contract modification). Increase the limitation of authorization for design, fabrication and testing of the JTF10A-32C engine. Naval Air Systems Command. N00019-69-C-0120

—Sperry Rand, St. Paul, Minn $1,606,600. Computers, switchboards, motor generators and consoles for shipboard use. $1,618,009. Computers and associated components. Work on both contracts will be done at St Paul, Minn. and Salt Lake City, Utah. Naval Ship Systems Command. N00024-69-C-1134. N00024-69-C-1149

17—Lockheed Aircraft, Burbank, Calif. $89,-562,000. P-3C aircraft. Naval Air Systems Command. N00019-69-C-0237.

—Westinghouse Electric, Pittsburgh, Pa. $10,000,000. Nuclear reactor compartment

» Naval Ship Systems Com-
N00024-67-C-5058
Aircraft, Stratford, Conn $2,-
(contract modification). Long lead
fort for HH-3E helicopters Naval
stems Command. N00019-67-C-0664.
x Wire & Cable Co., Newington,
1,500,000. Branch cable for use in
graphic research Naval Electronic
s Command N00039-69-C-3524
l Electric, Schenectady, N.Y. $24,-
Nuclear reactor compartment com-
' Naval Ship Systems Command.
-67-C-5321.
Rand Corp., Long Island City,
1,800,000 Production of computers
Ordnance Systems Command
-69-C-2304
Tractor & Equipment Co., Rock-
ld $1,678,372 Aircraft towing trac-
Chesterton, Ind. Naval Air Engi-
Center, Philadelphia, Pa N000156
1091
on Co., Bedford, Mass. $1,365,054
ct modification). Incremental fund-
Sparrow III missiles Naval Air
s Command N00019-67-C-0019.
American Rockwell Corp., Colum-
hio, $1,144,000. Lower skins, upper
and wing skins for RA5C aircraft
n Supply Office, Philadelphia, Pa.
-69-A-5202-0114
Aircraft, Fullerton, Calif. $5,-
. Navy tactical data system units
Ship Systems Command. N00024-
111
on Co., Portsmouth, R.I $3,235,110.
tion and restoration of sonar equip-
Naval Ship Systems Command.
-69-C-1131
Downey Construction Co., Mil-
, Wis. $2,549,972. Construction of
ctronic weapons precision facility
Naval Shipyard, Long Beach,
Naval Facilities Engineering Com-
N62473-68-C-0012.
ghouse Electric, Pittsburgh, Pa.
500 Design and and production of
propulsion components Naval
Systems Command. N00024-69-C-

est Welding & Mfg. Co., Alham-
alif $1,850,732 Construction of 52
milled mechanized landing craft.
Ship Systems Command. N00024-
251
Lumber & Millwork Corp., Bridge-
Va. $1,087,333. Weapons trailers
munitions handling. Naval Air En-
g Center, Philadelphia, Pa.
-69-C-1107
Aircraft, Stratford, Conn. $87,-
(contract modification) CH-53D
ers. Naval Air Systems Command.
-68-C-0471
Aircraft Corp., Stratford, Conn.
000 (contact modification) Long
me effort and material for HH-53
ers Naval Air Systems Command.
-67-C-0401
Electric, Utica, N.Y. $8,055,527.
processing systems for P-3C air-
Naval Air Systems Command.
-69-C-0270
Radio Co., Cedar Rapids, Iowa
36. Classified electronic counter-
equipment Naval Air Systems
nd. N00019-69-C-0084.
Machine Works, Inc., Niles, Ill $1-
Numerically controlled machine
profiles and contours propellers
Purchasing Office, Washington, D.C.
-69-C-0136.
Dynamics, Pomona, Calif. $1,-
(contract modification). AGM-78A
d ARM weapon systems. Naval
stems Command. N00019-67-C-0390.
Corp., San Jose, Calif. $2,301,244.
ring support for Navy assault
ious vehicles. Naval Air Systems
nd. N00024-69-C-2062.
Rand Corp., Charlottesville, Va.
097. Periscopes, repair parts and
ed technical data. Naval Ship
Command. N00024-69-C-5061.
l Electric, Binghamton, N.Y. $1.-
Automatic flight control systems.
Air Systems Command. N00019-
077.
on Co., North Dighton, Mass. $9,-
Production of AN/SPG-51C radar
d related equipment. Naval Ord-
Systems Command. N00017-69-C-

Webb Corp., Honolulu, Hawaii.
,000. Construction of housing units
am AFB, Hawaii; the Naval Com-
plex, Oahu, Hawaii, and the Pacific Mis-
sile Range, Kauai, Hawaii Mid-Pacific
Div, Naval Facilities Engineering Com-
mand, Honolulu, Hawaii N62471-69-B-
0278
—B-E-C-K Christenson Raber-Keif and Associates, Seattle, Wash $1,191,719. Construction of a hangar and a transmitter and electronics repair facility at the Naval Arctic Research Laboratory, Barrow, Alaska Northwest Div, Naval Facilities Engineering Command, Seattle, Wash. N62476-69-C-0076
—Healy Tibbitts Construction Co., Long Beach, Calif. $1,193,460 Construction of utilities for Pier Six at the Naval Shipyard, Long Beach, Calif Southwest Div, Naval Facilitiest Engineering Command, San Diego, Calif. N62473-68-C-0103
—Palmetto Construction Co, Charleston, S.C $1,076,994 Construction of a mine warfare school addition, Naval School of Mine Warfare, Charleston, S C Southeast Div, Naval Facilities Engineering Command, Charleston, S C N62467-68-C-0181

30—Southern Stevedoring Corp., Norfolk, Va $2,748,591 Stevedoring services for the Naval Supply Center, Norfolk, Va. Naval Supply Center, Norfolk, Va. N00189-69-D-0238
—Vitro Corp. of America, Silver Spring, Md $1,375,000 Engineering services to implement a configuration management control program on the USS Guitarro (SS-363) ASW combat system Naval Ordnance Systems Command. N00017-69-C-1415.

31—General Electric, Schenectady, N.Y $24,-550,000. Design and furnishing of nuclear propulsion components. Naval Ship Systems Command. N00024-67-C-5321.
—Tractor, Inc., Austin, Tex $1,650,000 Integrated logistic support investigations and studies for submarine radar Naval Ship Systems Command N00024-69-C-1051
—Raytheon Co., Lowell, Mass. $1,696,760 Modification kits for Sparrow III missiles Oxnard, Calif Navy Ships Parts Control Center, Mechanicsburg, Pa N00104-67-A-0006

DEPARTMENT OF THE AIR FORCE

2—Lockheed Missiles & Space Co., Sunnyvale, Calif $1,400,000 Launch support services for the Western Test Range, Vandenburg AFB, Calif Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. FO4701-68-C-0005.

3—Aerojet-General, Sacramento, Calif. $2,-414,000 Pre-production effort to support the FY 1970 requirements for Stage II motors for Minuteman III Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. FO4701-69-C-0138.
—Del E. Webb Corp., Phoenix, Ariz. $3,-320,777 Construction of 172 family housing units at George AFB, Calif Procurement Div., George AFB, Calif FO4609-69-C-0061.
—J. J. Cook Construction, Inc., Oklahoma City, Okla $3,157,710. Construction of 162 family housing units at Tinker AFB, Okla. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F34650-69-C-0218.
—Continental Aviation & Engineering Corp., Detroit, Mich. $2,115,270. Production of J69 aircraft engines. Toledo, Ohio. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0263

4—Sunstrand Corp., Rockford, Ill. $6,459,700. Production of constant speed drives and gear boxes for aircraft. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F34601-68-A-2298.
—F. D. Rich Co., Stamford, Conn $4,968,-000. Construction of 300 family housing units at Craig AFB, Ala. Base Procurement Office, Craig, AFB, Ala. F01602-69-C-0087.

5—Adventure Line Mfg. Co., Parson, Kan. $3,332,600. Production of bomb components Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69—C-2401.
—Victor Comptometer Corp., Rogers, Ark. $2,272,792. Production of bomb components. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah F42600-69-C-2395
—Bendix Corp, South Bend, Ind. $1,103,943. Production of wheels and main landing gear applicable to KC-135 aircraft. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F34601-67-A-2849.

6—Fairchild Camera & Instrument Corp., Syosset, N Y $1,380,000. Production of airborne camera systems Aeronautical Systems Div, (AFSC), Wright Patterson AFB, Ohio F33657-69-C-0172
—G&S Construction, Inc, Rapid City, S.D. $1,321,897 Labor, equipment and materials necessary to move 200 relocatable houses from Glasgow AFB, Montana, to Mountain Home AFB, Idaho, Procurement Div, Mountain Home AFB, Idaho. F10603-69-C-0087.

9—Hallicrafters Co., Chicago, Ill. $2,485,328 Modification kits and associated items of the ALT-28 airborne electronics system. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F34601-68-A-2915-RJ08.
—General Electric, Binghamton, N Y. $1,-500,000 Production of components for the AN/ASG-26 computing optical sight system Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0569

10—Westinghouse Electric, Baltimore, Md. $9,-000,000 Production of airborne countermeasure equipment. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0440

11—Aerojet General, Sacramento, Calif $8,-403,901 (contract increment) Research, development and production of Stage III motors for Minuteman missiles. Space & Missile Systems Organization, (AFSC), Norton AFB, Calif F04694-67-C-0004.

12—Modulux, Inc., Newark, Calif. $1,084,575. Production of modular relocatable buildings. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga F09603-69-C-1645

13—TRW, Inc., Redondo Beach, Calif. $6,-500,000. Development support for the Minuteman weapon system (for period ending June 30, 1969); $10,415,304. Non-development support of Minuteman weapon system (for period ending June 30, 1969). Work on both contracts to be done at Norton AFB, Calif. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-68-C-0163, F04701-68-C-0164.

17—United Aircraft of Canada, Longueuil, Quebec, Canada. $1,647,926. R4360 aircraft engine spare parts San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. N383-93300A.

18—Honeywell, Inc., Minneapolis, Minn $4,-359,300 Modification of the MB-5 automatic flight control system for F-101 aircraft. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F34601-68-C-4711.
—Boeing Co., Seattle, Wash. $1,900,000. Minuteman modernization program. Cheyenne, Wyo Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-A-0142.
—Curtiss-Wright Corp., Wood-Ridge, N J. $1,358,085. Production of spare parts for aircraft engines San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41608 69-A0057

20—Goodyear Aerospace Corp., Litchfield Park, Ariz. $1,936,418. Production of spare parts for the AN/APQ-102 radar system. Akron, Ohio and Litchfield, Ariz. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga F34601-68-A-3143.
—Maxson Electronics Corp., Great River, N.Y. $5,382,725. Production of fuse assemblies for bombs. Old Forge, Pa. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F34601-68-A-2701.
—Southwest Airmotive Co., Dallas, Tex. $2,034,215. Overhaul and modification of J-33 engines. Oklahoma Air Materiel Area, (AFLC), Tinker AFB, Okla. F34601-69-C-0096.

23—TRW, Inc., Redondo Beach, $3,400,000. Minuteman operational targeting verification and validation program. Norton AFB, Calif Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0121.
—General Electric, West Lynn, Mass. $16,-686,000. J85-GE-5G/13/17/17A Turbo-jet engines. Aeronautical Systems Div., (AFSC), Wright-Patterson, AFB, Ohio F33601-69-C-0065.

—Goodyear Aerospace Corp., Akron, Ohio $1,377,977 Large pallets for loading and unloading air cargo Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga F09603-69-C-1946

—General Motors, Indianapolis, Ind. $9,246,-236 Production of T56-A-14 turboprop engines Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio F33657-68-C-0706

—Lake McDonald, Inc., Vidalia, Ga $5,531,-100. Construction of a 300-unit adddition to the family housing area at Shaw AFB, S C. Procurement Div, Shaw AFB, S C. F38601-69-C-0065.

26—Superior Steel Ball Co., New Britain, Conn $2,330,477. Production of BLU 26 bomblet components Washington, Ind. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah F42600-69-C-2538.

27—Continental Aviation & Engineering Corp., Detroit, Mich $2,600,000. Production of J100 jet engines, Toledo, Ohio. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio F33657-69-C-0607.

—Singer-General Precision, Inc., Binghamton, N.Y. $1,400,000 Mission simulator and support items for F-111 aircraft Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-1239

—Sydney Construction Co., Brookline, Mass $1,961,500. Construction of family housing units at L. G Hanscom Field, Mass. Electronic Systems Div., (AFSC), L. G Hanscom Field, Mass. F19650-69-C-0421.

—Dallas Airmotive, Inc., Dallas, Tex. $1,-737,536. Overhaul of R2800 aircraft engines San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41608-69-D-0672.

30—Litton Systems, Woodland Hills, Calif. $9,153,917. Production of avionics subsystems for F-4 aircraft. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-094.

—Cornell Aeronautical Lab, Buffalo, N.Y. $2,297,097. Analysis and evauation of effectiveness of penetration aids Aeronautica Systems Div, (AFSC), Wright-Patterson AFB, Ohio F33615-68-C-1319.

—M.I.T., Cambridge, Mass $2,422,000. Basic research concerning the properties of matter in intense magnetic fieds. Air Force Office of Scientific Research. F44620-67-C-0047.

—I.B.M., Gaithersburg, Md. $1,600,000. Work on a large aperture seismic array experimental signal processing system. Electronic Systems Div., (AFSC), L. G. Hanscom Field, Mass F19628-68-C-0400.

—Raytheon Co., Waltham, Mass. $1,525,165. Production of electron tubes. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-68-A-0327.

—Bendix Corp., South Bend, Ind. $1,041,000. Overhaul and modification of engine fuel controls. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F34601-69-D-0731.

31—Lockheed Aircraft Service Co., Jamaica, N Y. $1,754,002. Maintenance and modification of special air mission aircraft for FY 69. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F34601-68-C-4334.

—General Electric, Cincinnati, Ohio. $2,-500,000. Engineering effort and services for J79-GE-10/-15/-17 aircraft engines for CY 1969. Evendale, Ohio Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0434.

—Canadian Commercial Corp., Ottawa, Ontario, Canada. $2,823,608. Weapons release control systems for F-4D/E aircraft. Aeronautial Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0634.

—AAI Corp., Cockeysville, Md. $1,031,088. Modification of fault detection testers for F-4C/D weapons control systems. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-0908.

OFF-SHORE PROCUREMENT

20—Canadian Commercial Corp., Ottawa, Ontario, Canada. $1,257,500. Production of pressure-temperature test sets and spare parts. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41608-69-C-7806.

Distributing the Risk

(Continued from page 10)

factors could work to the detriment of system quality and ultimate performance, a risk which has not developed in the C-5 but should not be tolerated.

While I believe that we cannot afford to relinquish the advantages of total package, I believe that we can, and must, find a way to modify our present method of implementing the total package. Thus the Air Force and industry would retain the advantages of production commitments obtained in competition. Modified procedures would, at the same time, avoid unnecessary design and development risk or exposure of the contractor to unreasonable financial risk.

I believe that we can improve the existing imbalance that apparently exists in the financial/technical risk tradeoff matrix. One way would be to raise significantly the fixed-price incentive contract ceiling and to use a shallow dollar share formula. Another way would be to return to the outright use of cost reimbursement type contract for development. Under this approach, the development through completion of Category II testing may be procured under a cost-type contract, while the production items would be procured on a fixed-type contract. I hasten to add that this approach would not merely be a commonplace combining of a cost plus incentive fee with a fixed price incentive fee contract, as we now use them.

I hope we can bridge the gap between the development contract and the production contract. I think the performance requirement, terms and conditions, and pricing methods can be established and negotiated under competition. For example, the first production run could be small, using a fixed price incentive contract with a high ceiling and steep share lines. Production Run B would be for a larger number of items, with the target adjusted on the basis of Run A experience, etc.

We may be able to use the design and performance achievements (made during development), for determining the successive formula production provisions.

My legal and procurement advisors foresee problems in assuring that costs, normally associated with production contracts, would not find their way into expenses incurred under the cost-type contract. They also see problems in assuring that non-recurring costs for redesign, resulting from development and testing problems, would not inflate the cost baseline for successive formula negotiations. My advisors believe I would be as vulnerable (under this approach) as poor old St. Peter. They may be right.

We have organized a group to seek ways to reduce the contractor's cost risks for design and development, while maintaining a firm production commitment, secured under a competitive environment. I an hopeful that proper safeguards can be established.

We Need Your Help

I am aware that I have discussed some things which are subjects of some emotion between the Government and contractors, and sometimes even within the Government itself. Differences of opinion will not go away in an area as vital as risk. However, additional experience in this area will tend to clean up many differences. The close Air Force/industry relationship has weathered successfully many changes since the days of the Wright Brothers, and I'm sure it will in this case.

In the past, industry has been helpful in reviewing and commenting on contracting procedurs. I challenge you to assist us in finding ways to reduce the design and technical risk, and to balance the scales of financial risk distribution in this case.

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Production Contract Awarded for New Jet Fuel Starter

A small gas turbine to be used as a starter for aircraft jet engines has been developed by the Aeronautical Systems Division of the Air Force Systems Command. The development has opened up a new family of starters which may be used on many Defense Department aircraft. Called the Jet Fuel Starter, the new device is more economical, lasts longer and requires less maintenance than other starting systems. It requires no ground support equipment.

An initial $9.5 million production contract for the starter has been let to AiResearch Division of Garrett Corp., Phoenix, Ariz., to support the A–7D aircraft. The system provides enough power to start engines in F–4, F–101, F–111, F–106, KC–135 and B–52 aircraft. Retrofit on several aircraft is under consideration.

The Jet Fuel Starter is completely self-contained. It uses only 1.5 pints of on-board aircraft fuel to start an engine. It weighs about 75 pounds, measures 19 inches long by 11 inches in diameter. It develops about 90 horsepower.

The new starter is of modular construction. Any or all of three modules can be replaced independently, reducing overhaul costs by an estimated 50 percent. The three modules are the gas generator, power turbine and accessory module.

Presently, aircraft are dependent upon either a starting cartridge, which is good for only one start at a cost of $12, or on a costly ground pneumatic power cart. The new starting system, by eliminating need for cartridges and ground power carts, will reduce world-wide logistics and will provide reliable, self-contained, quick start capability.

In addition to the technological advance of the system, the cost reduction to the Air Force is almost as significant. The new system has resulted in a validated cost saving of $3.7 million. The starter will be procured as Government Furnished Aeronautical Equipment.

Engineers who developed the starter over the past six years predict there may be many applications for general aviation. Studies are currently under way to determine future applications.

Army Seeks Modular Construction Equipment

It is called FAMECE for Family of Military Engineer Construction Equipment.

As seen in a study of combat engineer battalions in the mid-1970s, now being conducted by the Engineer Agency, U.S. Army Combat Developments Command, FAMECE would comprise a single rubber-tired power pod and a wide variety of work attachments to replace individually powered pieces of equipment.

Without using special tools, the operator could attach the power pod to special wheeled attachments in less than 30 minutes, making such items as a non-tracked bulldozer, front loader, grader, scraper, etc.

FAMECE will be designed to move over the road at convoy speeds, to work on steep inclines, and to be light enough to be lifted by helicopters of the 1970s or to be para-dropped. Initial plans call for FAMECE to be used in forward combat areas, but future studies will evaluate the equipment for operational, economic and productive feasibility in other areas and conditions.

DEFENSE INDUSTRY BULLETIN

March 1969

Melvin R. Laird
Secretary of Defense

David Packard
Deputy Secretary of Defense

DEFENSE INDUSTRY BULLETIN

5 No. 3 March 1969

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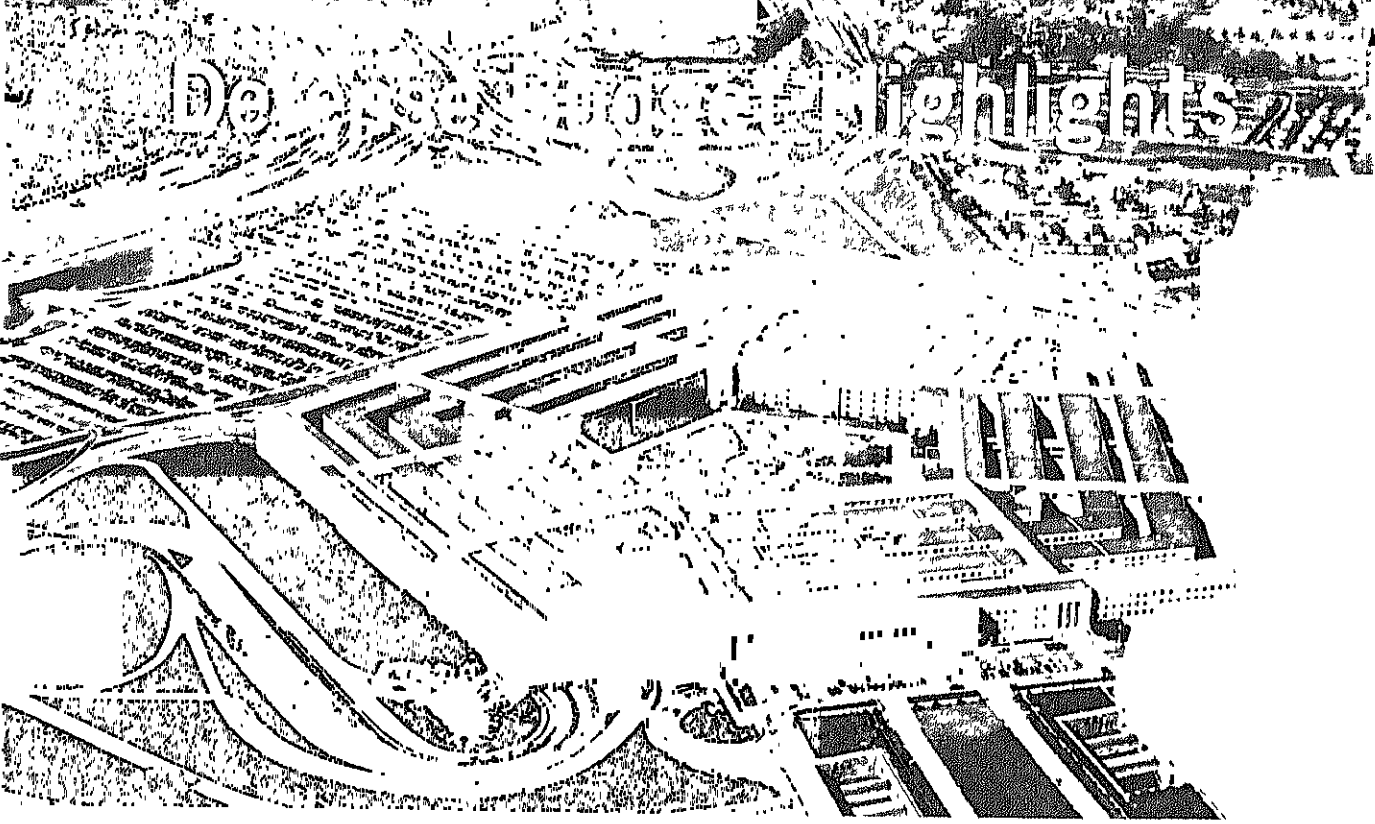
e *Bulletin* serves as a means of communication en the Department of Defense, its authorized ies, defense contractors and other business in- s. It provides guidance to industry concerning d DOD policies, programs and projects and to stimulate thought on the part of the De- Industry team in solving problems allied to ense effort.

gestions from industry representatives con- g possible topics for future issues are wel-

IN THIS ISSUE



Approach to the FY 1970-74 Program and FY 1970 Budget

[*Editor's Note: This issue of the* Defense Industry Bulletin *is devoted almost entirely to the statement on the FY 1970 Defense Budget and the FY 1970–1974 Defense Program released by former Secretary of Defense Clark M. Clifford on January 16, 1969.*

While space limitations permit only an abbreviated treatment of the statement, an attempt has been made to excerpt those portions which are of special interest to defense industry.]

In formulating our recommendations to the President on the FY 1970–74 program and FY 1970 budget, we have been very mindful of the extremely difficult financial situation confronting the nation, both at home and abroad. Wherever we could do so without endangering our national security, we have eliminated, stretched out, or deferred less essential projects and activities, thus reducing the FY 1970 budget requests of the Services and Defense Agencies by about $19.3 billion.

With regard to the conflict in Southeast Asia, it is clear that as long as U.S. and allied forces are engaged in combat, their needs must be provided in full. And, since we do not know at this time when or how the conflict might be terminated, we must assume for *budget purposes* that combat operations will continue at about their present levels through the various leadtimes financed in the FY 1970 budget, *e.g.*, 6 months beyond the end of the fiscal year for ammunition, 18 months for attrition aircraft, etc. If combat operations should cease within the year, some reductions could be made but, if the tempo of operations should rise above the levels projected, additional funds would be required.

With regard to the non-Southeast Asia portions of the program, we have again deferred those projects and activities which could safely be postponed to a later time and, of course, we have eliminated all nonessential and marginal items from the FY 1970 budget. However, there are a number of new programs of great importance to our future security, which cannot be safely deferred, and these will require greater amounts of funds in FY 1970 than in FY 1969.

We are requesting for FY 1970 a total of $80.6 billion in new obligational authority. Expenditures for that year are estimated at $79.0 billion, excluding those pay raises which will take effect automatically on July 1, 1969, and such other pay raises and changes in military compensations which may be enacted by the next session of the Congress. Provision for the pay raises are made in the Government-wide "Allowances for Contingencies."

We are also requesting a FY 1969 supplemental totaling $3 billion —$1.2 billion for the pay raises which went into effect on July 1, 1968 (an allowance for which had been made in the FY 1969 Government-wide "Allowances for Contingencies"), $190 million to cover increases in retired pay ($162 million) and certain reserve component personnel costs ($28 million), and $1.6 billion for additional Southeast Asia

requirements which arose subsequent to the transmission of the FY 1969 budget to the Congress last January. These latter requirements are related to the new actions taken early last year as a result of the Communist Tet offensive in South Vietnam and the crises provoked by the North Koreans with their seizure of the USS Pueblo. The major categories involved here are higher-than-planned military personnel and operations and maintenance costs, and increased ammunition and spare parts procurement. Taking into account these additional requirements, plus the expenditure impact in FY 1969 of the FY 1968 supplemental, minus the $8 billion mandatory reduction in FY 1969 expenditures, we now estimate expenditures for that year at about $78.4 billion.

Assessment of the International Situation as It Bears on Military Policies and Programs

I am pleased to be able to report that the military posture of the United States remains strong; our national security is not in jeopardy from any adversary. Moreover, the international situation, although certainly marked by some disquieting elements, nonetheless gives us overall grounds for considerable hope that we may be able to look forward to a world marked by a lessening rather than an intensification of conflict.

The grounds for hope reside especially in two aspects of the international situation. First, there is now reason to believe that, in some measure, we have succeeded in shifting the focus of confrontation in Vietnam from the arena of the battlefield to that of the conference chamber. We have forced the enemy to the realization that, though he can still inflict great injury and misery on the people of South Vietnam, he is incapable of winning a military victory; and, moreover, his capability is declining with the passage of time and the growing strength of our Vietnamese allies.

We can—and should—now move explicitly toward a reduction in the level of conflict, and toward the mutual reduction—and the eventual elimination—of outside forces from South Vietnam. Last year we began the process of turning over to the government of Vietnam more responsibility for the conduct of the war. This year the process should continue and, I hope, accelerate. But we must not delude ourselves that the shift of emphasis from battlefield to conference table means that the war is won, or that there will not be difficult days ahead. We have already seen how difficult it is simply to get negotiations started. We know that all the parties have much at stake which they will not lightly concede. But I think that we have now set a true course toward peace in Vietnam.

The second aspect of the international situation which seems to me distinctly hopeful is the stated willingness of the Soviet Union to discuss with us the mutual limitation of strategic nuclear weapons. I believe that this willingness evidences recognition that increased security cannot be found simply in the procurement of additional strategic weapons—which may mean instead merely another upward spiral of the arms race, the economic costs which such a spiral implies, and a net reduction in safety for all mankind.

In contrast to these two hopeful signs are the disquieting acts of continued Soviet armed presence in, and pressure on, Czechoslovakia in the aftermath of the invasion of that country last August, and the current exacerbation of the bitter, smouldering conflict in the Middle East. Yet even in these instances the total picture is not unrelievedly bleak. The angry reaction of virtually the entire world, including a number of the Communist nations, made plain to the Soviets just how unacceptable is their behavior in Czechoslovakia. Concurrently, the events of August have spurred the members of the Atlantic Alliance to a greater cohesion and sense of shared purpose. We hope that this new spirit and energy will persist beyond the tensions of the moment, since the Alliance remains the keystone of our foreign policy with respect to Europe.

Similarly, the prospects of renewed large-scale warfare in the Middle East may have introduced greater realism into the policies of the Great Powers, particularly those of the USSR. However, it would be overly optimistic to suggest that the issues which generate this poisonous conflict are any nearer a settlement.

By and large, the forces which make for international community rather than international division have been strengthened over the past 12 months. The steadiness of the United States—in continuing to meet its commitments in Vietnam, in reaffirming its support of the Atlantic Alliance, in seeking to moderate the conduct of both sides in the Middle East, in negotiating a non-proliferation treaty which takes account of the just interests of both the nuclear and the non-nuclear powers—has in no small way contributed to this strengthening.

We must continue to play such a role. We must make it clear that although a new Administration will bring with it new people and new ways of conducting our nation's affairs, the broad thrust of our approach to the great problems of our time will remain what it has been over the past two decades: timely assistance to our friends, prudent use of the great military power at our disposal, a willingness to place our energies and our resources behind peoples who are willing to devote their own blood and treasure to the preservation of their own freedom and national independence.

This is not—let me be clear—any unseemly display of our power. It is recognition of the simple fact that in our inactions as well as our actions, because of the size and the great productivity of our population, our international behavior is bound to affect the behavior of virtually every other state in the world of states, and to have effects upon the quality of their life. Even if we pursue a course of isolationism, we can never be truly isolated. Thus it is only prudent to work towards outcomes that we would desire, rather than merely to hope that they will come about in the absence of our action. The peoples of the world are interdependent and will remain so, much as some among us might wish to retreat in time to a point when that was not so.

Notions like these are scarcely novel. They have figured time and time again in the statements of the previous Secretary of Defense, and in those of his predecessors. But the

fact that all of the occupants of the office of Secretary of Defense have been convinced of their validity makes them no less important or meaningful today. They are notions which infuse all of the more detailed sections of this statement which follows. They are the reasons that we buy and maintain our military forces. And they are considerations which at all times govern the deployment of those forces.

* * * * * * * *

Military Assistance and Sales

There is no way to determine precisely what any nation's fair share of the burden of collective defense should be. In the past 20 years, the United States has transferred armaments valued at approximately $45 billion to allied and friendly nations in support of the policy of common security and a strategy based on forward defense. Over this span, the character of our contribution has changed significantly. I believe that it will change more in the years ahead. Whereas the annual total of military exports has remained relatively constant, there has been a rapid decline in grant materiel exported—from $4.2 billion in FY 1953 to $525 million in FY 1969—and a commensurate rise in the delivery of arms sold for either cash or credit.

In FY 1963 grant aid for materiel, training, or both, was programmed for 69 countries, the highest number of countries ever to receive U.S. grant assistance. By FY 1969 this number was reduced to 48 recipients. Such countries as Germany, Japan, the United Kingdom and France were able not only to support their own defense establishments without U.S. assistance, but also, in some cases, themselves to offer military aid to developing countries.

Regardless of the form of our assistance, its basic objective has remained the same: to ensure that other countries, individually and collectively, have the necessary military capability to deter aggression and, failing this, the capability to withstand an armed attack until supporting forces arrive. In brief, it is my belief that effective national forces in forward defense countries provide an in-place deterrent for which U.S. forces based outside that country are not a complete equivalent. To provide this deterrent on a long-term basis in such countries by deploying U.S. forces would tie them down, restrict the flexibility of U.S. decision making, and create the host of economic and political problems inherent in the stationing of foreign troops in sovereign nations.

Such forward defense countries as Korea, Taiwan, Greece and Turkey maintain defense establishments which they can neither completely equip nor adequately support from domestic resources without detriment to their economic development. We assume a portion of the costs of their military forces as part of our own defense burden. Where their economic strength has grown and circumstances permit, we have shifted more of the total defense burden to local governments through a phasedown of grant aid. Generally, the impact of the shift has been eased by utilization of credit sales. As these countries become able to finance their legitimate defense needs wholly from their own resources, we would expect to phase out U.S. Government credit as well. In some countries, however, for political as well as for military reasons, we shall probably want to retain the option of extending credit to facilitate sales of U.S. equipment and materiel.

In planning our military assistance and sales, we utilize a total resource approach. This involves not only U.S. military assistance and foreign military sales and credit, but all U.S. and foreign aid, including excess and long-supply transfers and programs financed by the Agency for International Development, and an analysis of the recipient country's own resources. Coordination with U.S. economic programs and the recipient's resources is essential for these countries, since we are striving to assure that U.S. military assistance is gradually phased into their own economic planning—ultimately having all key forward defense countries on a self-sustaining basis.

In accord with the obvious sentiment of the Congress and the changed priorities imposed by the budgetary demands of the Vietnam conflict, our proposed FY 1970 grant military assistance request under the Foreign Assistance Act is being held to the lowest level since the inception of the program in FY 1950. Our request totals $375 million, with first priority to be accorded to four forward defense countries, *i.e.*, Greece, Turkey, Korea, and Taiwan (almost 90 percent of the total). Based on experience and administrative factors, the U.S. share for support of International Military Headquarters and related agencies has been transferred for funding to the regular Defense Department budget.

The remainder of the FY 1970 program is in support of U.S. base rights in such countries as Ethiopia and Libya, modest training programs, and small but important internal security programs. In summary, in FY 1970, 22 countries will receive grant materiel aid and training while 26 countries will receive training alone. The total number of countries receiving some type of assistance under the Military Assistance Program is, therefore, 48.

As I have indicated, sales now constitute a substantial part of our overall arms transfer program. Total sales orders for FY 1970 are estimated at about $1.6 billion. Of this total, we expect government-to-government cash orders of about $600 million, and cash orders placed directly with U.S. industry of some $400 million. An additional $350 million will be against credit arranged for or provided by the Defense Department under the provisions of the Foreign Military Sales Act, and $250 million against credit arranged for by the Export-Import Bank for the industrial countries.

Impact of the Defense Program on the Balance of Payments

The year of 1968 witnessed a substantial improvement in the U.S. international balance of payments (IBP) position. The overall "liquidity" deficit for the first nine months of CY 1968 was running at an annual rate of about $1.1 billion, compared with a deficit of $3.6 billion for all of CY 1967. Based on preliminary data, the "official settlements" balance showed a surplus during the first nine months of CY 1968 running at an annual rate of $1.9 billion. In 1967, there was a deficit

of $3.4 billion on the "official settlements" basis.

The 1968 results to date are a cause for some encouragement. The measures undertaken in accordance with President Johnson's balance of payments action program of January 1, 1968, to control direct investment abroad and foreign lending by U.S. banks and other U.S. financial institutions, together with an increased flow of foreign capital to the United States, have been major factors underlying the improvement in 1968. However, the U.S. trade account surplus deteriorated seriously during the year. Accordingly, the President's balance of payments action program has been extended into 1969, as announced last December.

The Defense Department has had for a number of years an extensive program to minimize the impact of its activities on our balance of payments. Figure 1 summarizes the balance of payments position on the defense account through FY 1968.

As can be seen, prior to the intensification of hostilities in Southeast Asia, we had reduced the net adverse balance on the defense account by almost half, from $2.8 billion in FY 1961 to $1.5 billion in FY 1965. This reduction was achieved in large part by a fourfold increase in our receipts (which stem primarily from sales of U.S. military goods and services to foreign countries), a reduction in uranium purchases abroad for defense purposes, and a successful effort to hold down our overseas expenditures in the face of substantial increases in foreign prices and wages and in the pay of U.S. Defense Department personnel.

Beginning in mid-1965, our expenditures increased rapidly due primarily to the conflict in Southeast Asia. In FY 1968, about $1.6 billion, or more than one-third of our total balance of payments expenditures, were attributable to that conflict. The rate of increase, however, slackened substantially during the year as U.S. troop deployments in the area were stabilized.

During the past year we have intensified our efforts to minimize the net impact of our activities on the nation's balance of payments wherever we could do so without reducing necessary combat capability or creating undue hardship for our personnel and their dependents. Last fall we completed a reduction of approximately 35,000 military personnel in Western Europe, under previously announced plans. More recently, we succeeded in reducing our subsistence expenditures abroad by about $20 million and in holding down construction costs. We also have re-emphasized programs to hold down spending by our personnel stationed abroad. Our efforts in this area rest primarily on voluntary actions by our personnel stationed overseas to reduce expenditures in the local economy and to increase savings. In addition, new government-wide programs were undertaken to reduce the number of U.S. civilians working overseas and to reduce expenditures for official travel.

nts

FY 1967	FY 1968
$4.0	$4.4
.1	.1
**	**
$4.2	$4.5
−1.8	−1.2
$2.4	$3.3
(1.8)	$1.6)

Notwithstanding these efforts, defense expenditures abroad in FY 1969 are likely to continue their upward trend, albeit at a slower rate. Price and wage increases abroad, as well as pay raises for our own personnel, combined with somewhat higher average U.S. personnel strengths in South Vietnam will contribute to this trend.

Accordingly, we have renewed our efforts to achieve reductions, principally by further streamlining and tightening our operations overseas. Last year we focused particular attention on our operations in Western Europe, and we now plan to take a number of actions there which should have a beneficial effect on our balance of payments in FY 1970–71. We have also initiated an intensive examination of operations in Japan and Okinawa with the hope that some reductions might be feasible even under present conditions.

We have continued to maintain the military sales program, discussed earlier in this statement. In FY 1968, Defense Department receipts, which stem principally from this source, were at a level of about $1.2 billion, considerably below FY 1967. But as we indicated last year, FY 1967 receipts were abnormally high due to fulfillment of a payments commitment by the Federal Republic of Germany under the then existing military offset arrangements.

In this connection, it should be noted that the data shown in Figure 1 do not reflect the actions taken to neutralize the impact of defense spending abroad through special financial arrangements, such as the sale of U.S. long-term securities. Purchases of such securities by the Federal Republic of Germany and similar arrangements with other countries resulted in a capital inflow of about $800 million during FY 1968. If these financial arrangements are included, the net adverse balance on the military account for FY 1968 would be approximately the same as in FY 1967. We fully recognize, of course, that these financial arrangements do not represent a long-term solution to our balance of payments problem, and we will continue our efforts to achieve more permanent types of neutralization arrangements.

Strategic Forces

The forces and programs included under this heading, *i.e.*, the strategic offensive forces, the strategic defensive forces, and the civil defense program, constitute the foundation of our general nuclear war capabilities and are, accordingly, treated in this section of the statement as an integrated whole.

The Size and Character of the Threat

The continuing rapid expansion of Soviet strategic offensive forces, which could bring them abreast of the United States in numbers of land-based missiles by mid-1969, has become a matter of increasing concern. Other developments in the Soviet strategic forces, both offensive and defensive, together with the entry of Communist China into the ranks of the nuclear powers have added further complicating factors to the strategic equation. It might be useful, therefore, to commence this discussion of our strategic forces with a careful reexamination of the size and character of the threat as we see it now and over the next few years.

Again, our usual note of caution should be borne in mind as we discuss these most recent intelligence estimates. While we have reasonably high confidence in the estimates for the closer-in period, *i.e.*, through mid-1970, the projections beyond that point become progressively less certain, especially where they extend past the production and deployment leadtimes of the weapon systems involved.

Soviet Strategic Offensive and Defensive Forces

Summarized in Figure 1 are the Soviet strategic offensive forces estimated for Sept. 1, 1968. The programmed U.S. forces for this same date are shown for comparison.

Intercontinental Ballistic Missiles. We estimate that as of Sept. 1, 1968, the Soviets had approximately 900 ICBM launchers operational, compared with 570 in mid-1967 and 250 in mid-1966—an increase of well over threefold in a period of a little more than 2 years. The rate of increase over the past year has been somewhat greater than estimated a year ago. However, we believe the rate of increase will be considerably smaller over the next two or three years. Beyond that point, our estimates become less firm.

We have been anticipating for some time a Soviet deployment of a solid fuel ICBM. We now believe the deployment of such a missile has started, although at a relatively slow rate.

With regard to the Soviet Fractional Orbit Bombardment System (FOBS), which attracted so much attention last year, our estimates are now quite uncertain. It is possible that the Soviets are trying to develop a weapon which could perform as a depressed trajectory ICBM, a FOBS, or a dual system. A system of either type could reduce the possibility of timely detection by our Ballistic Missile Early Warning System (BMEWS), but not by our planned Over-The-Horizon (OTH) and satellite-borne missile warning systems. Neither missile system, however, would have a very high order of accuracy and, therefore, they would be useful primarily against soft targets. Because of the uncertainties concerning the characteristics and purposes of this weapon system, we are unable at this time to estimate its deployment. Accordingly, it has been dropped from the estimates as a separate system and included with the other weapon systems launched by the same booster.

Submarine-Launched Ballistic Missiles (SLBMs). We have known for some time that the Soviets were constructing a new class of nuclear-powered ballistic missile submarines, and that they were testing a new submerged-launched ballistic missile out to a range of about 1,500 nautical miles. The first of these new submarines became operational last year. Together with a number of older H-class vessels, the Soviets in September 1968 had approximately 45 SLBM launch-

U.S. vs Soviet Intercontinental Strategic Nuclear Forces

	Sept. 1, 1968 U.S.	Sept. 1, 1968 USSR
ICBM Launchers [a]	1,054	900
SLBM Launchers [b]	656	45
Total Intercontinental Missile Launchers	1,710	945
Intercontinental Bombers [c]	646	150
Total Force Loadings—Approximate Number of Warheads	4,200	1,200

[a] U.S. and Soviet ICBM launchers used for training and development are excluded. Training and development launchers are included in the total force loadings. Only submarine-launched ballistic missiles (SLBMs) on deployable submarines are included in total force loadings.

[b] In addition to the SLBMs on nuclear-powered submarines, the Soviets have SLBMs on diesel-powered submarines whose primary targets the intelligence community estimates to be strategic land targets in Eurasia. The Soviets also have submarine-launched cruise missiles whose primary targets are believed to be naval and merchant vessels.

[c] We include only heavy bombers which could fly two-way intercontinental missions. The Soviets also have a force of medium bombers and tankers capable of striking Eurasian targets.

Figure 1.

ers in their nuclear-powered ballistic missile submarine force. In addition to the SLBMs on nuclear-powered submarines, the Soviets have SLBMs on diesel-powered submarines whose primary targets the intelligence community estimates to be strategic land targets in Eurasia.

As noted on previous occasions, the Soviets do not appear to consider their cruise missile submarines a strategic attack system. We believe they are designed primarily for use against ships, but can be used against shore targets.

Manned Bombers. The estimate of the Soviet manned bomber force is essentially the same as presented last year. There is still no evidence that the Soviets intend to deploy a new heavy bomber in the early 1970s. In addition to the 150 heavy bombers shown in Figure 1, the Soviets also have over 700 medium bombers.

Medium Range Ballistic Missiles (MRBMs) and Intermediate Range Ballistic Missiles (IRBMs). No significant changes have occurred in the overall size of the Soviet MRBM and IRBM forces during the last year. These forces appear to have leveled off with about 700 operational launchers, some of which are hardened. However, evidence is accumulating that the Soviets have embarked on the development of solid fuel missiles for medium and intermediate, as well as intercontinental ranges.

Manned Interceptors. The Soviet strategic interceptor force now consists of several thousand aircraft, but a slow downward trend has been in evidence for a number of years. Moreover, a large percentage of that force still consists of subsonic or low-supersonic models introduced in 1957 or earlier, *i.e.*, Mig–17s, Mig–19s and Yak–25s. Most of these older models are day fighters and are armed with guns or rockets. A smaller portion of the force is composed of supersonic all-weather interceptors introduced in 1959–64, which are armed with short-range, air-to-air missiles. A still smaller portion of the force is made up of new aircraft, *i.e.*, Yak–28s, TU–28s and the Flagon–A, equipped with longer-range missiles and improved radars. We believe the last two models are still in production and will continue to enter the force.

Beyond the Flagon–A is the Foxbat. This aircraft, still in the development stage, is no doubt a very high performance fighter interceptor.

Surface-to-Air Missiles. Except for the so called "Tallinn" system, there have been no significant changes in the deployment of surface-to-air missiles in the Soviet Union during the last year. With respect to the Tallinn system, the passage of another year has convinced a majority of the intelligence community that it is designed against fast, high flying aerodynamic vehicles, rather than ballistic missiles, although the latter is a possibility which cannot be excluded. As expected, the deployment of this system is continuing.

Anti-Ballistic Missile Defense

During the past year, the Soviets apparently curtailed construction at some of the Galosh ABM complexes they were deploying around Moscow. The significance of this action cannot as yet be ascertained. However, it is the consensus of the intelligence community that the Galosh system, as presently deployed, could provide only a limited defense of the Moscow area, and could be seriously degraded by currently programmed U.S. weapon systems. Nevertheless, until we achieve a workable agreement with the Soviet Union on the limitation of ABM deployments, we must continue to plan our strategic offensive forces on the assumption that they will have deployed some sort of an ABM system around their major cities by the mid-1970s.

The Chinese Communist Nuclear Threat

The Chinese Communists have had for a number of years the technical and industrial capabilities required for the development and deployment of nuclear-armed ballistic missiles. From October 1964 through December 1967 they detonated seven nuclear devices, including three thermonuclear and one low yield device delivered by a missile. (On Dec. 27, 1968, the Chinese Communists detonated their eighth nuclear device. This test was similar to the sixth, conducted in June 1967. Both were apparently thermonuclear devices with yields of about three megatons which were air-dropped. The seventh test, conducted in December 1967, was apparently a partial failure.)

On the basis of the first seven nuclear tests and their continuing

work on surface-to-surface missiles, we estimated last year that they could have their first MRBMs (700–1,000-nautical mile range) deployed as early as 1967–68, and that by the mid-1970s they could have a modest force operational. However, we still have no firm evidence indicating deployment of these missiles. The apparent failure to begin deployment at least by the end of 1968 would seem to indicate that they have encountered serious problems with the initial system, or that the program has simply fallen victim of the Cultural Revolution and the widespread disruption which that revolution has caused throughout the entire fabric of Chinese society. If the latter, work on these missiles may have been resumed by now, as was the case with the nuclear tests. But in view of all the uncertainties, we now believe that an initial operating capability with an MRBM will occur later than previously estimated.

These same circumstances have also caused us to alter our estimates on the deployment of a Chinese ICBM. Two years ago we had estimated that they would conduct either a space or a long-range missile test launching before the end of 1967. We now believe that an initial operating capability with an ICBM will not be achieved until 1972 at the earliest, and more likely later. In any event, we will almost certainly detect extended range firings once they begin and that should give us some advance warning of an initial operating capability.

We have no basis at this time for estimating how far or how fast the Chinese will carry deployment of their first generation ICBM. Assuming that political and economic stability will be reestablished within the next year or so, China could probably generate enough resources to support a moderate and growing ICBM deployment through 1975. Beyond that time frame, there is a possibility that China might significantly improve the initial system, which we believe will not have a very high degree of survivability, accuracy, or reliability.

The Chinese Communists also have several types of aircraft which could carry nuclear weapons, but most of them have a limited operational capability and none have an intercontinental radius. It is highly unlikely, on the basis of cost alone, that they would undertake the development, production and deployment of an intercontinental bomber force. If they chose to do so, it would take them a decade or more before they could deploy such a force.

Strategic Nuclear War Policy

It is quite apparent from the foregoing review of the threat that the Soviet Union is moving vigorously to catch up with the United States at least in *numbers* of strategic missiles—both land-based and sea-based. But, it is also apparent that they are still well behind us in advanced missile technology—accuracy, multiple independent reentry vehicles (MIRVs), and penetration aids. Indeed, their new solid fuel ICBM appears to be no better than our earliest Minuteman missiles, first deployed in FY 1963. Their new ballistic missile submarine is probably most comparable to our earliest Polaris submarines which first became operational about a decade ago. Their Galosh ABM system resembles in certain important respects the Nike-Zeus system which we abandoned years ago because of its limited effectiveness. Their Bison and Bear long-range bombers are distinctly inferior to our B-52s, and we have long since eliminated from our forces the B-47s which were clearly superior to their Badger medium bombers.

Accordingly, it is reasonable to conclude that even if the Soviets attempt to match us in numbers of strategic missiles we shall continue to have, as far into the future as we can now discern, a very substantial qualitative lead and a distinct superiority in the numbers of deliverable weapons, and the overall combat effectiveness of our strategic offensive forces. But even so, we should have no illusions that superiority alone will guarantee our safety. It has become increasingly clear over the years since the end of World War II that once the Soviet Union, as well as the United States, acquired large, protected intercontinental strategic offensive forces neither one could expect to emerge from an all-out nuclear exchange without very grave damage —regardless of which side had the most weapons or which side struck first. This is so because of the enormous destructive power of a single nuclear weapon, the speed and accuracy with which it can now be delivered to its target, and the very great technical difficulties involved in defending against any very large number of them.

Many knowledgeable Americans, both within and without the Government, have wrestled with this problem over the years. There is now a very broad consensus that until a truly safeguarded nuclear disarmament agreement is achieved in the context of viable world-wide security arrangements, the only realistic policy we can pursue at this particular juncture is one of deterrence. In other words, we must be prepared to maintain at all times strategic forces of such size and character, and exhibit so unquestionable a will to use them in retaliation if needed, that no nation could ever conceivably deem it to its advantage to launch a deliberate nuclear attack on the United States or its allies.

While the general policy objective of deterrence has been clearly defined and firmly established in recent years, the size and character of the forces required for its support remain the subject of continuing debate. In large part, this debate is concerned with the number and kinds of specific weapon systems and when they should be introduced into our forces. These issues can never be finally resolved, inasmuch as the strategic threat confronting the nation is continually changing, and our own advancements in military technology are always opening up new possibilities for both offense and defense.

But, in addition to these specific weapon systems issues (which will be discussed in detail later), there is a more fundamental problem, and that is the relative weights which should be given to our "Assured Destruction" and "Damage Limiting" objectives in planning our strategic forces. (Assured Destruction is defined as the ability to inflict at all times and under all foreseeable conditions an unacceptable degree of damage upon any single aggressor, or a combination of aggressors—even after absorbing a surprise attack. Damage Limiting is the ability to reduce the potential damage nuclear attack upon the Unite through the use of both and defensive weapons.)

It is generally agreed that the primary deterrent is our ability to destroy the attacker in retaliation, even after absorbing his first blow, and not our ability to limit damage to ourselves. Damage limiting measures could, of course, contribute to the deterrent—if they could be made truly effective, *i.e.*, reduce damage to some nominal level even after the opponent responded by increasing his offensive forces. But on the basis of our present knowledge of military technology, we still see no practical way in which to do this against the kind of attack the Soviets could potentially mount in the 1970s. Accordingly, our best alternative is to continue to base our policy of deterrence primarily on our Assured Destruction capability.

Even so, it could still be argued that some Damage Limiting capability should be provided as a hedge against the possibility that deterrence might fail. This matter has been vigorously debated over the last four or five years, but the prospects for even a reasonably effective Damage Limiting capability against the Soviet ballistic missile threat are quite uncertain because the USSR could make offsetting improvements in their missile forces which could seriously reduce the effectiveness of any extended ABM defense we might choose to deploy at this time.

The provision of an effective Damage Limiting capability against Communist China is quite another matter. As noted earlier, the Chinese strategic threat, at least through the mid-1980s, is expected to consist of a relatively small force of first generation ICBMs. Against such a force, a thin ABM defense, such as our presently planned Sentinel system, is both technically and economically feasible and should be able to offer a very high degree of protection to our population and industry. The Sentinel system could, of course, be employed against a Soviet ICBM attack as well, but it would have little effect on the final outcome of that attack. Its existence, however, will contribute to our deterrent by complicating the Soviets' targeting problem and adding to the many uncertainties which are already inherent in planning a strategic nuclear attack.

We remain convinced, however, that insofar as the Soviet threat is concerned, we should continue to give first priority in the allocation of available resources to the primary objective of our strategic forces, namely, Assured Destruction. Until technology progresses to the point where an effective ABM defense against the Soviet threat becomes feasible, our major hope for limiting damage if a nuclear war occurs is that it can be stopped short of an all-out attack on our cities. We try to bring this about by providing our forces with characteristics that will permit them to be used effectively in a limited and controlled retaliation as well as for Assured Destruction, thereby being prepared for any type of Soviet attack.

We also remain convinced that we must explore with the utmost diligence every avenue of negotiation which might lead to a meaningful and verifiable agreement on the limitation of strategic forces—both offensive and defensive. We stand on the eve of a new round in the armaments race with the Soviet Union, a race which will contribute nothing to the real security of either side while increasing substantially the already great defense burdens of both. Conversely, an appropriately designed and safeguarded limitation agreement can maintain our deterrent posture at present levels and enhance the stability of the strategic balance. The Soviet incursion into Czechoslovakia made the opening of talks on this matter inappropriate last year. It is our hope that the Soviet leaders will reestablish an atmosphere in which talks can begin.

Meanwhile, we should move forward promptly on the ratification of the Non-Proliferation Treaty which now lies before the Senate. This treaty does not provide any unique advantages for the Soviet Union. The United States and all other signatory nations will share equally from the benefits which it provides.

Capabilities of the Proposed U.S. Forces for Assured Destruction

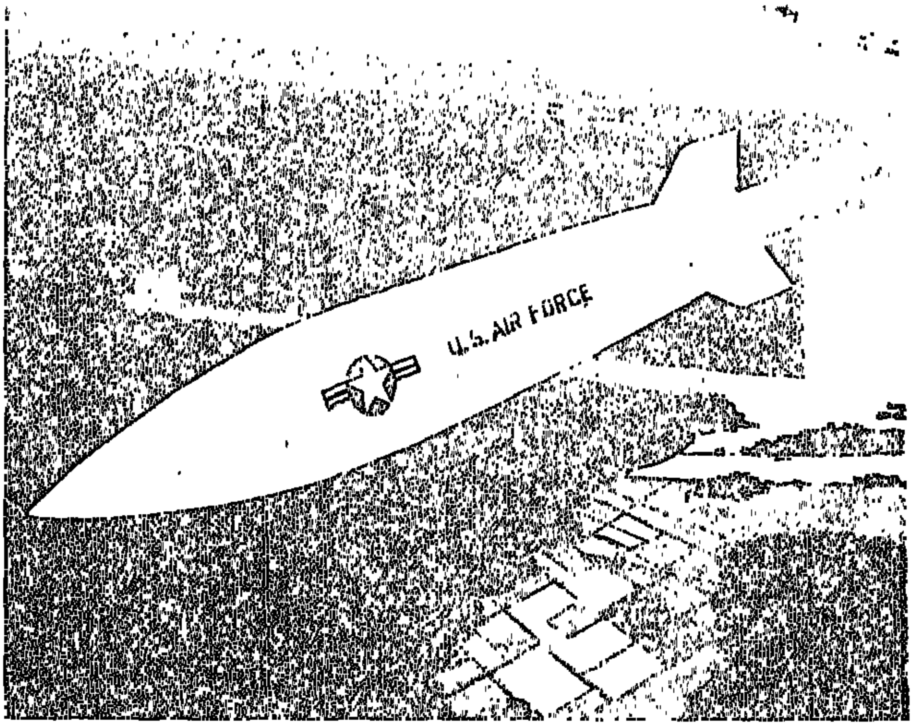
While numbers of Soviet and U.S. warheads, delivery systems, megatons, and many other factors are taken into account in the analysis of our strategic forces requirements, the soundest measure of the effectiveness of these forces in the Assured Destruction role is their ability, even after absorbing a well-coordinated surprise strike, to inflict unacceptable damage on the attacker. The following two sections of this statement summarize the results of our most recent analysis of our Assured Destruction capabilities: first, against the "Highest Expected Threat" projected in the latest National Intelligence Estimates (NIE) . . . and, second, against a "Greater-Than-Expected Threat" specifically designed to test the adequacy of our forces in the unlikely event that the Soviets move significantly beyond our highest expectations.

Capability Against the "Highest Expected Threat" in the NIE

Our calculations indicate that the U.S. strategic forces programmed over the next few years, even against the highest Soviet threat projected in the NIE, would be able to destroy in a second strike more than two-fifths of the Soviet population and about three-quarters of their industrial capacity.

With regard to Communist China, a relatively small number of warheads detonated over the 50 largest cities would destroy half of their urban population and more than half of their industry. While these cities contain a relatively small proportion of China's total population, they do account for most of the key government officials and a large majority of the scientific, technical and skilled workers.

Thus, by any definition of the term, our Assured Destruction capability now, and over the next several years, should be fully adequate even against the highest expected threat projected in the most recent NIE. This capability, however, is of such crucial importance to our security, providing as it does the very sinew of our deterrent policy, that we must always be prepared to cope with unexpected developments in the Soviet strategic threat. Accordingly, we must continually reexamine the various ways in which the Soviets might seek to strengthen their strategic forces beyond what now seems probable, and take appropriate actions now to hedge against them.



SHORT RANGE ATTACK MISSILE (SRAM), to strengthen the penetration capabilities of our manned bombers against a possible vastly improved Soviet air defense system.

Capability Against "Greater-Than-Expected Threats"

There are a number of ways in which the Soviets might attempt to degrade our Assured Destruction capability in the 1970s. They could develop and install highly accurate MIRVs in their large ICBMs; greatly improve the accuracy of their missiles; construct an extensive, effective ABM system (including both area and terminal defenses); and deploy a large Airborne Warning and Control System (AWACS)/interceptor force with a good look-down, shoot-down capability, together with an extensive, effective low altitude surface-to-air missile (SAM) system.

Any one of these actions alone would pose no particular threat to our Assured Destruction capability. But, if they were to do all of these things simultaneously, which would appear to be highly improbable on purely economic grounds, they might be able to degrade seriously the Assured Destruction capability of our strategic forces as presently planned. A Soviet ICBM force with a substantial hard target kill capability would be able to destroy a large number of our land-based missiles in hard silos. An extensive, effective Soviet ABM defense might then be able to intercept and destroy a large part of our residual missile warheads, including those carried by submarine-launched missiles. A large AWACS/interceptor force (with a good look-down, shoot-down capability), coupled with an extensive, effective low altitude SAM system, could destroy a very sizeable number of our bombers before they could reach their targets.

While the foregoing threat is both quantitatively and qualitatively far greater than that projected in the latest intelligence estimates, we cannot foreclose the possibility that all of these developments may occur, and occur simultaneously. Accordingly, we must take timely action now to place ourselves in a position where we can move forward promptly to meet any or all of these threats should they actually materialize.

We have already taken a number of important actions which would permit us to cope with a large scale Soviet ABM system, *e.g.*, Minuteman III, Poseidon and the missile penetration aids program. To hedge against the possibility that the Soviets might install MIRVs in their large ICBMs and greatly improve the accuracy of their smaller ICBMs, we have initiated the development of a super-hard silo which could accommodate the Minuteman III or a new, larger ICBM. To improve the survivability of our alert bombers from an SLBM attack, we are developing an early warning satellite and dispersing our bombers to secondary bases so that our alert bombers can be launched in the warning time provided by the satellite. To strengthen the penetration capabilities of our manned bombers against a possible vastly improved Soviet air defense system, we are producing a new Short-Range Attack Missile (SRAM), and are developing a new long-range Subsonic Cruise Armed Decoy (SCAD) for both our B-52 and FB-111 bombers. And, of course, we are doing preliminary development work on a new sea-based missile system, a new land-based missile system, and a new manned bomber.

In addition to the actions already taken, we have a number of other available options. We can increase from 40 to 60 percent the proportion of bombers held on 15-minute ground alert; expand the presently planned Sentinel system to include the defense of our Minuteman sites; accelerate the deployment of Minuteman III; load the Poseidon with more warheads than presently planned (or add penetration aids); and construct new ballistic missile submarines. If the emerging threat requires, we can accelerate development of a new, larger land-based or sea-based missile, a new manned bomber—known as the Advanced Manned Strategic Aircraft (AMSA), or all three.

We need not take any of these steps until we have some evidence that the threat is actually beginning to emerge. Instead, we should carefully pace our actions on all of them in step with the development of the threat, keeping in mind the various development, production and deployment leadtimes involved. Maintaining a reasonable balance between each of the threats and each of the responses at all times is admittedly a very difficult task. But, taking our strategic posture as a whole, we have an ample margin of safety and we can afford to proceed with due deliberation on very costly new programs. Our technological base in this area is very deep and bro[illegible] there is no reason why [illegible] not be able to respo[illegible] effectively, to any t[illegible] prises on [illegible] Union.

Capabilities of the Proposed Forces for Damage Limitation

As was the case last year, the two major issues in this portion of the strategic forces program concern the deployment of an anti-ballistic missile defense system and the future size and composition of the anti-bomber defense forces.

Anti-Ballistic Missile Defense

No single defense issue in recent years has engendered greater controversy than the question of deploying an ABM defense. Differences in viewpoint on this matter range across the entire spectrum—from no deployment at all to massive deployment against the Soviet threat. Involved in this issue are a variety of foreign policy, strategic, technical and economic questions—all of which are interrelated. High on the list of the foreign policy questions is the effect of a U.S. ABM deployment on the prospects for successful negotiations with the Soviet Union on the limitation of strategic forces and, in the absence of negotiations, its impact on the U.S.-Soviet strategic competition. The strategic and technical questions are closely intertwined and have to do chiefly with the action-reaction phenomena inherent in the Assured Destruction -Damage Limiting problem, both for ourselves and the Soviet Union. It stands to reason that if both sides are indeed determined to maintain an Assured Destruction capability against each other, then each side will be forced to react to any attempt by the other significantly to increase its Damage Limiting capability. The economic questions involve primarily the high cost of ABM defenses and the impact of these costs on other national programs, both military and civilian.

To a considerable extent, the deep division of opinion on the ABM deployment issue is a result of the widely differing emphasis given to these various questions. For example, those who are primarily concerned with the economic and social costs of the program tend to denigrate

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threat tend to stress the technical feasibility of the system and take a more relaxed view of the economic and social costs.

Certainly, there is ample room for differences of judgment on each of these questions, but these differences should not be allowed to obscure the basic facts about the system—its technical feasibility, its cost and its effectiveness in various roles and against various threats. After almost a decade and a half of research and development effort and the expenditure of more than $4 billion, Defense Department and contractor personnel most closely associated with the project are fully convinced that an ABM defense system is technically feasible in the sense that they believe we can develop and install a system which would be able to identify, track and destroy an incoming ballistic missile warhead under certain specified conditions. How effective such a system would be against an actual attack is quite another matter. That would depend upon the purpose the system is intended to serve.

We have defined, over the last few years, at least three major purposes for which we might want to deploy an ABM system:

- Defense of our Minuteman silos as a partial substitute for the further expansion of our offensive forces in the event the Greater-Than-Expected Soviet threat begins to emerge.
- Protection of our population and cities against the kind of limited and unsophisticated ICBM attack the Chinese Communists might be able to launch in the 1970s (and an accidental or unauthorized firing from any source).
- Protection of our population and cities against the kind of heavy, sophisticated missile attack the Soviets could launch in the 1970s.

The first major purpose has already been touched upon in connection with the discussion of our Assured Destruction capabilities against the Greater-Than-Expected Soviet threat. To the extent that a defense of Minuteman can be distinguished from a defense of our cities, such an ABM deployment improves our Assured Destruction capability without threatening the Soviets' Assured Destruction capability. The other two major purposes, however, are directly related to our Damage Limiting capabilities; the second complicates, while the third would threaten the Soviets' Assured Destruction capability.

Defense Against the Chinese Communist Nuclear Threat. As noted earlier, although the Chinese Communists have yet to launch their first ICBM, we still believe they are working on such a system and intend to deploy it. They have clearly demonstrated their ability to develop and produce nuclear warheads, and we have ample evidence that they have been testing medium range ballistic missiles. Even if their ballistic missile programs proceed at the relatively slow pace of the past year, they could have a modest force of ICBMs sometime after the mid-1970s.

In the light of Chinese Communist progress in nuclear weapons and missile delivery systems, and given the present hostility of the Chinese leadership towards the United States, we believe it is both prudent and feasible on our part to deploy the Sentinel ABM system designed to protect against this threat.

Moreover, we believe that our possession of such a defense would provide greater assurances to the non-Communist nations of Asia that we intend to support them against attempts at nuclear blackmail by China and, thus, help to convince them that the acquisition of nuclear weapons is not required for their security.

As shown in Figure 2, a ballistic

U.S. Fatalities from a Chinese First Strike, 1975–1980

No. of Chinese ICBMs	x	2.5x	7.5x
U.S. Fatalities (millions)			
Without Sentinel	7	11	28
With Sentinel	*	*	1

* Fewer than one million U.S. dead, with some probability of no deaths.

Figure 2.

missile defense system specifically designed against the Chinese threat *i.e.*, the Sentinel system with its Perimeter Acquisition Radars (PARs), Missile Site Radars (MSRs), long-range Spartan area defense missiles and Sprint local defense missiles for the defense of the PARs, would offer a high degree of protection for our entire population.

As indicated in the third column of Figure 2, without the Sentinel system we might suffer as many as 23 million fatalities from an attack by a Chinese ICBM force. With the Sentinel, we might be able to hold fatalities to 1 million or less.

There should be no question about the technical feasibility of the system against the kind of Chinese ICBM threat shown in Figure 2. We already know enough about the radars and missiles to have confidence that they will perform as expected, and that the system as a whole will have a very high level of effectiveness against such a threat.

Whether this degree of protection is worth the initial investment cost of the Sentinel system ($5 to $6 billion) is a matter of judgment. If those who believe that the possibilities of a Chinese Communist ICBM attack upon the United States are extremely remote under any conceivable circumstances are correct, the cost of the Sentinel system would be excessive. But, if those of us are correct who believe that an ABM defense against China will provide a measure of insurance that our strategic deterrent will, under *all* circumstances, remain credible to China and our allies, the cost would be commensurate with the benefits received.

If and when the Chinese ICBM force continues to grow, quantitatively and qualitatively, beyond the levels shown in Figure 2, improvements can be made in the basic Sentinel system to maintain its effectiveness. We believe that for relatively modest additional outlays the system can be improved so as to limit the Chinese damage potential to low levels into the mid-1980s.

The Sentinel system would also have a number of other advantages. It would serve as a foundation to which we could add a defense for our Minuteman and bomber forces, if that later becomes desirable. Or, if technology progresses to a point where the deployment of an ABM defense against the Soviet Union becomes feasible, and otherwise desirable, it could serve as a base for a larger, more extensive system. Finally, it could protect our population against the improbable, but possible, accidental launch of a few ICBMs by any one of the nuclear powers.

Deployment of ABM for Defense of Our Cities Against Soviet Attack. While we are convinced that an effective ABM defense against the kind of threat the Chinese Communists might be able to mount in the 1970s and early 1980s is both technically and economically feasible, we are equally convinced that such a defense against the Soviet threat is not presently attainable. In contrast to Mainland China, the Soviet Union has the technical and economic resources needed to offset any strategically significant Damage Limiting advantages we might gain by the deployment of an extensive ABM defense.

Accordingly, if we believe that the Soviets are determined to deter us by maintaining a capability to inflict great damage upon us, we must also assume they would act promptly to offset any extensive ABM defense we might choose to deploy by increasing the effectiveness of their strategic offensive forces. They could do so by installing MIRVs and penetration aids in their currently projected missile forces, deploying new, larger payload mobile ICBMs, deploying more SLBMs, etc. In that event, we would still find ourselves in a position where a Soviet attack could inflict unacceptable damage on our population and cities, even after we have spent many billions of dollars for ABM defense.

Conversely, should the Soviets seek to limit damage to themselves by deploying a large ABM defense, we would be forced to increase the effectiveness of our strategic offensive forces as, in fact, we have already done to a considerable extent in anticipation of just that eventuality.

Thus the deployment of an extensive ABM defense by either side will, in all likelihood, simply fuel the strategic armaments race, with great additional costs but no commensurate benefits to either side. It was primarily for this reason that President Johnson two years ago proposed to the Soviet Union the opening of talks leading to an agreement on the limitation of ABM deployments, specifically, and strategic forces, generally. In July of last year, we and the Soviets confirmed our agreement to hold talks on limiting offensive and defensive missiles at an early date. Notwithstanding the delay made necessary by the Soviet invasion of Czechoslovakia, that is still our objective.

Meanwhile, we propose to press forward energetically with the Sentinel program and the development of more advanced ABM technology. Until a workable agreement with the Soviet Union on these matters is achieved, we must keep open the option of deploying an ABM defense against the Soviet missile threat should such a defense prove to be both feasible and desirable at some future time.

Anti-Bomber Defense

A year ago the Defense Department presented to the Congress a new plan for the modernization of our air defense forces. This plan was the product of a very comprehensive analysis of the air defense problem—the purposes an air defense system might serve in the 1970s, the possible future threats, the status of our technology, and the effectiveness and cost of the major alternatives available to us.

Briefly, the analysis delineated six possible purposes:

- Peacetime identification.
- Limiting damage to our cities from a Soviet manned bomber attack.
- Preventing damage from an air attack by other countries, *e.g.*, Cuba.
- Precluding a manned bomber attack on our withheld strategic missile forces.
- Discouraging the Soviet Union from developing and introducing new bomber threats which would be costly to neutralize.
- Providing a complete mobile "air defense package."

Although the Soviet heavy bomber force is expected to continue its gradual decline and medium bombers are not expected to play an important role in an attack on the continental United States, a number of Greater-Than-Expected threats were also taken into account. These included the possibility that the Soviets might use their medium bombers in one-way attacks against the continental United States, the deployment of a new, intercontinental supersonic

bomber, and the introduction of a new, long-range, air-to-surface missile.

Three alternative "modernized" U.S. air defense forces, in addition to the current force, were evaluated against each of the foregoing purposes and threats: AWACS and F-12s; AWACS and F-106Xs; AWACS, F-106Xs and a few F-12s. In all but the "current force" alternatives, the entire SAGE-BUIC ground environment would be phased out, leaving only the FAA-operated radars for peacetime air surveillance, plus the new Over-The-Horizon (OTH) "backscatter" radars to provide an aircraft early warning capability.

The alternative with the lowest investment cost would obviously be the current force, but it would also be the one with the highest annual operating cost. Of the three modernization alternatives, the AWACS/F-106X force would have the lowest investment and annual operating cost, while the AWACS/all F-12 force would have the highest.

With regard to effectiveness, we have reached the following major conclusions:

- No air defense system can provide a significant Damage Limiting capability against the Soviet Union unless accompanied by a strong, effective ABM defense.
- The AWACS/F-12 force should be superior in discouraging the Soviet Union from deploying a new, long-range, air-to-surface missile (ASM) or a new intercontinental supersonic bomber, whereas the AWACS/F-106X force would be superior in discouraging them from deploying SRAMs, decoys and self-defense missiles on their bombers. The AWACS/F-106X force would also be superior against the present Soviet bomber threat.
- In any "modernized" air defense force, AWACS would be of the first order of importance, the fire-control/missile system, second, and the performance of the interceptor aircraft, third.
- Even if the Soviets were to phase out their remaining bomber force, the AWACS/F-106X would provide the most flexible force for use in theater air defense and special contingencies.

Since we have no evidence that the Soviets are developing either a new, long-range ASM or a new intercontinental supersonic bomber, the AWACS/F-106X force seems to be the proper choice at this time.

The remaining portions of this Strategic Forces section of the statement deal with our specific proposals for the FY 1970–74 period.

AIRBORNE WARNING AND CONTROL SYSTEM. In any "modernized" air defense force, AWACS would be of the first order of importance.

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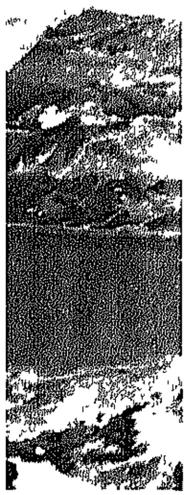


Strategic Offensive Forces

Strategic Bomber Forces

The manned bomber forces which we propose to maintain through FY 1974 differ in three major respects from those presented to the Congress last year for the FY 1969–73 period. First, we now propose to cut back the FB-111 force from the 14 combat squadrons (210 unit equipment aircraft) planned last year. Second, we plan to retain the B-58 force beyond the previously planned phase-out date in FY 1971. Third, we plan to retain a number of B-52C–Fs in the force instead of retiring all of them by end FY 1972 as previously planned. In addition, we propose to continue with competitive designs for the AMSA to provide a hedge against our possible bomber requirements in the late 1970s.

Our continuing study of the manned bomber requirement during the last year has reenforced our previous conclusion that the principal problem in this area of the program is penetration capability, more specifically, the ability of the force to survive in a much more advanced Soviet air defense environment in the mid-1970s. What is needed to operate effectively in such an environment is not so much a new aircraft, but rather new penetration aids and weapons. One of these new weapons, the Short-Range Attack Missile (SRAM) is now well along in development and will be entering the forces in the early 1970s. Development will be initiated in FY 1970 on still another new weapon, the Subsonic Cruise Armed Decoy (SCAD). Work is also continuing on a variety of improved electronic warfare countermeasures equipment.

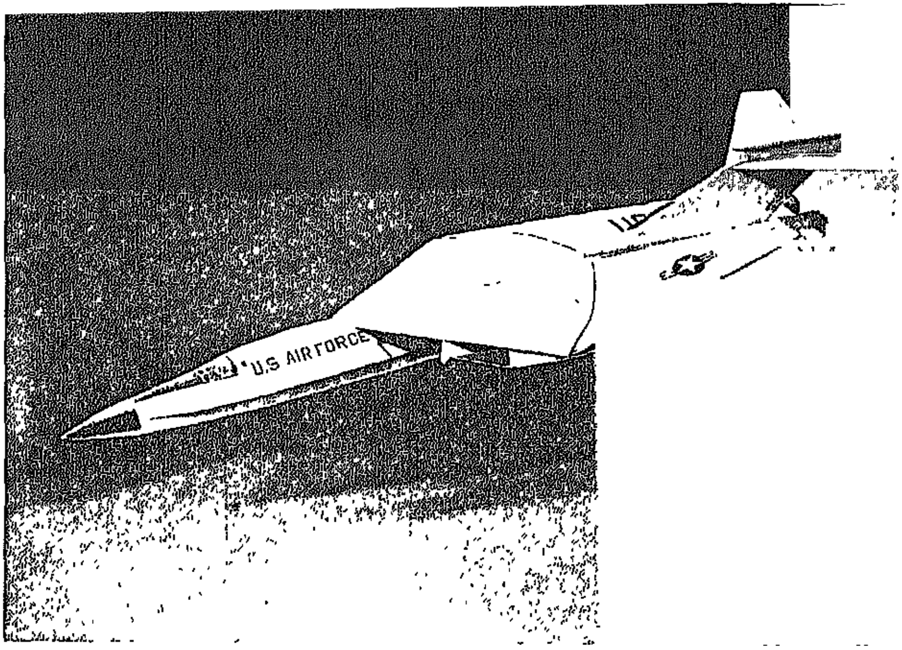
Because the FB-111 is considerably smaller than the B-52, it cannot carry the kind of penetration payload required to cope successfully with a Soviet AWACS/interceptor force possessing a good look-down, shoot-down capability. Furthermore, once we introduce SCAD and SRAM into the force, the FB-111 becomes relatively much less effective because it can carry far fewer of these weapons than the B-52. Finally, the cost of the FB-111, for a number of reasons,

is running considerably higher than estimated at the time the decision was made to proceed with deployment.

In the light of these developments, we believe it would be advisable to reduce the FB-111 force levels. A total of 104 complete aircraft plus long leadtime components for eight more are already on order. (This program reflects the reductions made by the Congress in the FY 1969 defense budget.) We now plan to complete the funding of the eight advance procurement aircraft and buy a sufficient number of additional aircraft to complete the equipping of the authorized squadrons and provide for command support, training and advance attrition. Because of this change and the need to modify the wing box, the first FB-111s will enter the force in early FY 1970 instead of late FY 1969.

The B-58s and the current Hound Dog air-launched "stand-off" missiles for the B-52s would be retained in the forces until the SCAD became available. The B-52C-Fs will be retained to provide a conventional bombing capability should that be needed sometime in the future. Finally, plans are being made to place ourselves in a position to increase promptly the number of bombers on sustained 15-minute ground alert, from the current 40 percent to 60 percent, if that should become necessary to protect our Assured Destruction capability. We also plan to provide "satellite basing" for our bomber force, as indicated earlier.

Although we are still uncertain whether a new intercontinental bomber will be needed in the 1970s, we do believe it would be prudent to keep the program moving in such a way as to reduce leadtime and protect an initial deployment date of FY 1977 or FY 1978. Accordingly, \$77 million has been included in the FY 1970 budget to continue the competitive design phase initiated with FY 1969 funds, and to advance the development of the long leadtime avionics and propulsion systems. This new bomber (AMSA) would, of course, be designed to carry both the SRAM and the SCAD as well as nuclear and conventional gravity bombs.



ADVANCED MANNED STRATEGIC AIRCRAFT. We propose to continue with competitive designs for the AMSA to provide a hedge against our possible bombers requirements in the late 1970s.

Missile Forces

In overall terms the missile forces we are proposing for the FY 1970-74 period are essentially the same as those presented to the Congress last year—1,000 Minuteman, 496 Poseidon and 160 Polaris at the end of FY 1974, plus 54 Titan IIs through FY 1973. The only significant change from last year concerns the Poseidon program, the phasing of which has had to be altered to conform with Congressional action on our FY 1969 budget.

Minuteman. The Minuteman forces now proposed for the FY 1970-74 period involve only minor changes in the mix of Minuteman I, II and III. The Minuteman Is, which began to be replaced by Minuteman IIs in FY 1967, will later be replaced by Minuteman IIIs. The number of Minuteman IIs, the final buy of which was made in FY 1968, will begin a gradual decline as the missiles used for follow-on operational readiness tests are also replaced with Minuteman IIIs. Flight testing of the Minuteman III is progressing, and the first of these missiles will soon be entering the force.

We have also included funds in the FY 1970 budget to continue the development and test of a dual-purpose, super-hard silo for the Minuteman III or a new land-based ICBM.

Titan II. Although the Titan II, with its large warhead, will still be useful against undefended large soft targets, its importance will decline greatly when large numbers of Minuteman IIIs and Poseidons enter the forces. Accordingly, we believe that after FY 1973 we can safely permit the Titan force to decline as the missiles on hand continue to be used for follow-on operational reliability testing without replacement.

Polaris/Poseidon. The Poseidon refit program presented to the Congress last year entailed the conversion of 31 nuclear-powered ballistic missile submarines (SSBNs) on a schedule tied to their regular overhaul cycle. Funds for the first two conversions were provided by the Congress in FY 1968. Six more conversions were requested in the FY 1969 budget, but the Congress provided funds for only two more in the belief that the program should be slowed down until flight tests had clearly established that there were no development problems with Poseidon and its MIRV concept. . . .

Accordingly, we have developed a new schedule which retains the beginning and end dates but rephases the conversion program in the intervening years. Under the new schedule, two SSBNs are funded in FY 1968, two in FY 1969, six in FY 1970, seven in FY 1971, six in FY 1972, five in FY 1973 and three in FY 1974 this permitting completion of the program in FY 1975 as previously planned. Funds are in-

AIR FORCE MISSILE CREW mates nose cone to Minuteman III prior to test firing from silo. Any new land-based system should be deployed in super-hard silos. We are already developing super-hard silos.

cluded in the FY 1970 budget for six conversions plus advanced procurement for future conversions. . . .

New Strategic Missile Systems. Last year we informed the Congress that we had reached two main conclusions with regard to new strategic missile systems:

- That any new land-based system should be deployed in super-hard silos and perhaps defended by some sort of ABM system.
- That any new sea-based system should be designed around a longer-range missile in order to avoid having to station the launch platform within the effective operating range of an improved Soviet anti-submarine warfare (ASW) defense. Also, the submarine design should make it possible to increase time on-station substantially.

It is quite evident that if the Soviets achieve greater accuracy with their ICBMs, together with a MIRV capability, our land-based strategic missiles will become increasingly vulnerable to a first strike. Accordingly, the silos in which they are installed must be further hardened, defended with ABMs, or both. We are already developing super-hard silos; for which another $58 million is requested in the FY 1970 budget. And, we are also keeping open the option to defend these silos with ABMs.

While we do not as yet see a need for a new land-based strategic missile, we believe the advanced technology required should be developed and $20 million has been included in the FY 1970 budget for that purpose. Moreover, the super-hard silos now being developed will be designed so that they could accommodate a new, large ICBM as well as the Minuteman III.

We are also requesting $20 million in the FY 1970 budget to prepare for possible engineering development in FY 1971 of a new Undersea Long-range Missile System (ULMS). (About $5 million was provided in FY 1969 to initiate a study of such a system.)

No significant changes have been made in the other strategic offensive forces included in this program.

Strategic Defensive Forces

Bomber Defense

As noted earlier, much of the existing U.S. anti-bomber defense system can be phased out when the new AWACS, Over-The-Horizon radars and modified F-106X interceptors become available in the mid-1970s. The proposed AWACS force and the new Over-The-Horizon (backscatter) radars would replace all but two of the SAGE Centers, five of the planned 15 BUIC III Control Centers, more than half of the search radars, all of the Gap Filler and DEW Line radars, and all of the existing surveillance and warning aircraft.

The proposed F-106X force would replace all of the older type interceptors (both active and reserve), except for one squadron of 28 F-102s in Hawaii.

With regard to surface-to-air missiles, the Bomarcs will be phased out of the force as previously planned. The number of onsite Nike-Hercules will decline during FY 1969–70, and then be continued at the end FY 1970 level throughout the remainder of the program period. The Hawk force will be maintained unchanged at the current level.

The over-land radar technology program is progressing satisfactorily and the tests to date have been encouraging. Contract definition has been initiated and engineering development of the AWACS system can be started in FY 1970. About $40 million is available for this purpose in FY 1969, and an additional $75 million is requested in the FY 1970 budget. . . . If all goes well, the

first of these aircraft should enter the force in the mid-1970s.

Although the Congress did not appropriate the $28 million requested in FY 1969 for the development of the modifications required for the F-106X, we believe we can still come close to achieving the original schedule, providing that at least $18.5 million is appropriated for FY 1970. The first of the modified F-106s would enter the force one year earlier than the AWACS.

The "back-scatter" Over-The-Horizon radars could become operational in the early 1970s. One million dollars is available for the development of this system in FY 1969 and $3 million more is requested for FY 1970.

Missile and Space Defense

Included under this heading are the anti-satellite and anti-ballistic missile defense systems, as well as attack warning.

Anti-Satellite Defense. As described in previous years, we have a capability to intercept and destroy hostile satellites within certain ranges. The capability will be maintained throughout the program period.

Satellite tracking and identification are provided by the SPASUR and SPACETRACK systems. . . .

Warning. For early warning of ballistic missile attack we now depend upon the Ballistic Missile Early Warning System (BMEWS), consisting of three radar sites guarding the northern approaches; and the "forward-scatter" Over-The-Horizon (OTH) radar system consisting of a number of transmitting and receiving stations at various locations. . . .

We are also requesting funds in the FY 1970 budget for the satellite "early warning" system, mentioned earlier.

ABM Defense. For active defense we are deploying the Sentinel system. . . . The system approved for deployment is essentially the same as that presented to the Congress last year.

The program is moving forward on schedule, except for some small delays which will be made up before the planned full operational date. . . .

The development of all five major components making up the Sentinel system is proceeding on schedule. The PAR, which is used for long-range surveillance, acquisition and tracking is a state-of-the-art, low frequency, phased array radar and no development prototype is deemed necessary. . . . The radar is still in the design stage.

The first MSR, which is used both for tracking the target and the defending missile, has completed factory tests and is now being tested at Kwajalein.

The Sprint missile, which is designed to attack incoming warheads after the atmosphere has helped to separate out the accompanying decoys, chaff, etc., is in the test firing state. . . .

The Spartan missile, which will be used for area defense, is in the flight test stage at Kwajalein, and these tests, too, are proceeding satisfactorily.

The fifth major component, the data processing system, is being installed at the contractor's plant and is partially operational. A second system is being installed at Kwajalein for use in the full systems tests.

For the Sentinel system, alone, we have included in the FY 1970 budget a total of about $1,788 million: $335 million for research and development; $736 million for procurement; $647 million for construction; and $70 million for operations. The FY 1969 budget provides a total of $962 million: $331 million for research and development; $346 million for procurement; $266 million for construction; and $39 million for operations. (Funds for ABM warhead development and production are included in the Atomic Energy Commission budget.)

In addition to the research and development work directly associated with the Sentinel system approved for deployment, we will continue our efforts to develop even more advanced ABM systems. These efforts are carried on primarily under the Nike-X Advanced Development Program, for which $175 million is included in the FY 1970 budget. (The $175 million figure includes about $40 million formerly carried in the Advanced Research Projects Agency (ARPA) Defender program which is concerned with the exploration of advanced technology for both missile offense and defense. For management convenience, those activities which are directly identifiable with anti-ballistic missile defense have been transferred from Defender to Nike-X Advanced Development.)

The FY 1970 budget also includes $16 million for Air Force and Navy support of the Kwajalein test program, $83 million for the support of the Kwajalein test range (which is also used for reentry tests and experiments), and $72 million for ARPA's Strategic Technology programs (most for exploratory work on offensive systems).

We have also included $3 million to continue our study of a sea-based ABM intercept system (SABMIS). Such a system would provide depth to the continental U.S. defense.

Civil Defense

The Civil Defense program proposed for FY 1970 contemplates no important change in basic objectives from those which were discussed last year. The FY 1970 request is being held at the lowest possible sustaining rate, pending the end of the Vietnam conflict.

. . . By the end of FY 1969 we will have identified 185 million spaces with a standard protection factor of 40 or more, of which 105 million will have been marked and over 95 million stocked with an average 8 days of austere supplies. Continuing survey and design assistance efforts should add about 70 million spaces to the national shelter inventory in the next five years.

Even with the large shelter inventory projected for the mid-1970s, up to one-half the population would still lack standard (PF-40) fallout shelter. This situation can be altered only by developing additional means to increase the inventory *where needed.* We are, therefore, proposing a modest test of a fallout shelter support program (for which we have included $2.5 million in the FY 1970 budget) to determine the effectiveness of small incentive payments made to owners of new building projects for the inclusion of additional fallout protection in these buildings through the use of low cost design and construction techniques.

. . . a total of $75.3 million is requested [for the Civil Defense Program] for FY 1970. . . .

General Purpose Forces

The General Purpose Forces consist of those land, sea and air units on which we rely for all military actions short of strategic nuclear war. These forces include most of the Army combat and combat support units, all of the Marine Corps units, virtually all of the Navy units (except ballistic missile submarines), and the tactical units of the Air Force. This year, for the first time, we are presenting these forces in terms of their basic mission—land, sea and air combat—instead of the traditional grouping by Service, since it is in those terms that the requirements are determined.

The Requirement for General Purpose Forces

As we have noted in previous years, the overall requirements for General Purpose Forces rest on two very fundamental policy judgments: that the security of our nation is inextricably bound up with a forward defense and, thus, with the security of our allies; and that strategic nuclear forces, in themselves, cannot be relied upon to provide a credible deterrent or a reasonable response to the entire spectrum of aggression which we must be prepared to face.

The first judgment has given rise, nce the end of the Second World 'ar, to a series of collective de-·nse agreements with almost half .e nations of the Free World. Some these agreements clearly require to consider an attack against an y as an attack against ourselves; ıers contain commitments of a more ıeral nature. But all of them repreıt, to a greater or lesser degree, ıtingencies for which we must proe, and these contingencies, in the ₃regate, constitute the principal urces of requirements for General ırpose Forces.

The fact that we must have plans deal with each of the contingen-:s does not mean that we must prepared to deal with all of them nultaneously, but neither can our potential opponents, and that is the crux of the matter. Accordingly, we continue to design our General Purpose Forces (active and reserve) to meet simultaneously the more probable contingencies. In addition, our General Purpose Forces provide a strategic reserve sufficient to meet unforeseen emergencies.

We believe the validity of the second basic policy judgment is confirmed by our experience with armed conflicts since the end of World War II. This experience has clearly demonstrated that strategic nuclear forces cannot be relied on to deter lesser levels of conflict. Nor can they serve as a substitute for properly trained, equipped and manned General Purpose Forces in dealing with such conflicts. Accordingly, we must continue to support adequate General Purpose Forces in the future.

* * * * * * * *

Logistics Requirements

The logistics requirements for the General Purpose Forces are computed on the basis of a single standard of logistics readiness so as to ensure that our inventories of equipment, secondary items, ammunition, and other combat consumables are in proper balance with our forces and contingency war plans. The forces, for this purpose, are divided into four categories, each of which is assigned an appropriate logistics standard:

- The NATO category covers those forces which we support mainly for the defense of NATO.
- The indefinite combat category includes those forces which are maintained for use where we can predict neither the place nor the duration of combat.
- The Southeast Asia category includes the forces in combat in that theater.
- The "Other" category includes those forces which, for purposes of logistics guidance, do not fit into any of the first three categories. These forces, in general, provide the training, rotation, attrition reserves, and overhaul base for forces deployed in Southeast Asia, or are maintained against the possibility of such a need.

Land Forces

We plan to maintain through FY 1970 the 32⅔ active and reserve Division Force Equivalents (DFEs) which we have today. These forces include 19⅔ divisions in the active Army, 4 in the active Marine Corps, 8 in the Army Reserve Components, and 1 in the Marine Corps Reserve.

As noted in previous years, a Division Force Equivalent is the aggregate of:

- The Division itself (or its approximate equivalent in three independent brigades).
- An Initial Support Increment (ISI)—non-divisional units which are needed in the theater to support the division from the outset of combat.
- A Sustaining Support Increment (SSI)—follow-on non-divisional units required to sustain the division in combat indefinitely. (Marine Corps DFEs do not include SSIs since they receive their sustaining support, when required, as in Vietnam, from Army and Navy units.)

Since ISI units normally deploy with divisions, they must be maintained at the same readiness for deployment as divisions. SSI units for active divisions, however, usually deploy later and most can be maintained at lower readiness levels, with some in the Reserve Components.

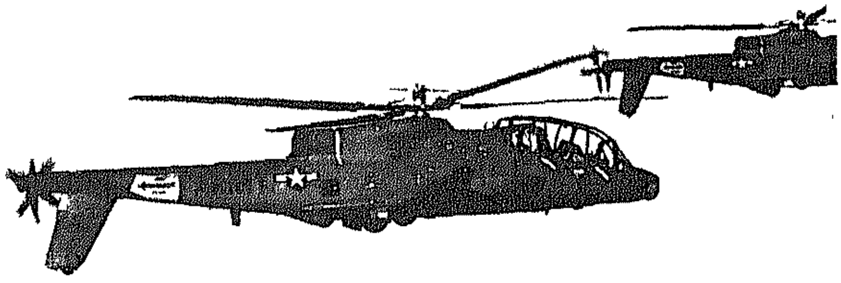
Shown in Figure 1 is the planned allocation of the 32⅔ DFEs at end FY 1970, including the temporary augmentations for Southeast Asia.

Seventeen of the 23⅔ active division forces will continue to be deployed overseas leaving 6⅔ in our active Continental U.S. forces. Backing up the active forces, we will continue to have 9 DFEs (8 Army and 1 Marine Corps) in the inactive Reserve Components, along with some additional support units to round out the active forces.

Although the total number of DFEs remains the same as reported to the Congress last year, there have been several changes in deployment and composition. Within the last 12 months we increased our deployments to Southeast Asia by two-thirds of a DFE, and completed the redeployment from Europe of two brigades

of the 24th Infantry Division (Mechanized) and their ISI and SSI support units (two-thirds of a DFE).

Originally, we had planned to replace the remaining brigade of the 24th Infantry in Europe with one from the United States on a six-month rotation schedule. In addition, we had planned to exercise all three brigades in Europe once each year. We have now been advised by our commanders in Europe that the "rotation" feature would not be worth the extra cost and personnel difficulties involved. Accordingly, we have decided to cancel the "rotation" feature of the plan and permanently station one brigade in Europe and two in the United States. This decision, however, will not affect the plan to maintain the two brigades in the United States under the operational command of U.S. Commander in Chief, Europe, and to exercise the complete division in Europe once every year to demonstrate its readiness.



CHEYENNE. The planned force of 375 AH-56A compound fire support helicopters will replace a variety of artillery, tank, anti-tank, and other older types of aviation units.

Army Division and Brigade Forces

While there has been no change in the Army total of 27⅔ DFEs planned for end FY 1969, there have been adjustments within that total. One of the measures made necessary by the 1968 Revenue and Expenditure Control Act was the inactivation of the new 6th Infantry Division while still in the process of formation. . . .

The active division and brigade force structure as now planned for end FY 1969 will be continued unchanged through FY 1970. However, by December 1969, all of the reservists called up in May 1968 will have been released from active duty and the units called up will then be transferred back to the Reserve Components. These units will be replaced by new units activated at that time so that the active Army force structure will remain unchanged.

The conversion of the 101st Airborne Division (currently in Vietnam) to an Airmobile Division will be completed by the end of FY 1969, as planned last year.

Army Supporting Forces

Most of the changes that have occurred during the past year within maneuver battalions, cavalry squadrons, field artillery battalions, signal battalions and construction battalions are related to the changes made in the division and brigade forces. However, there is one change of a different character which deserves special mention. Starting in late FY 1970 the new AH-56A "compound" fire support helicopter will be introduced into the forces. The planned force of 375 AH-56As will replace a variety of artillery, tank, anti-tank and other older types of aviation units on an equal cost tradeoff basis. That is (1) the forces being replaced cost as much over a 10-year period as the new AH-56 units being introduced, and (2) Army estimates that the new AH-56 units will add more combat power than that given up in the units being replaced.

Army Aviation

Since 1965 the UH-1 "Huey" helicopter has been the workhorse of our current force (*i.e.*, roughly one-half of the total helicopter inventory), but it is not an optimum system for the transport of combat units. . . . Consequently, we plan to initiate contract definition in FY 1970 for the design of a new Utility Tactical Transport Aircraft System (UTTAS). This aircraft will be able to carry about double the number of troops, plus a crew of three. We estimate that the 10-year system cost of a UTTAS-equipped helicopter force could be only a little more than half the cost of operating a UH-1 force with an equivalent lift capability over the same period of time.

Planned Allocation of DFEs at End FY 1970

	Division	ISI	SSI
Deployed			
Total	17	17	10⅔
Continental United States: Active*			
Total	6⅔	6⅔	2
Continental United States: Inactive			
Total	9	9	15
World-wide			
Total	32⅔	32⅔	27⅔

*Includes the ⅔ division force recently withdrawn from Europe in the REFORGER action, which remains under USCINCEUR operational command.

Figure 1.

Army Missile Forces

As noted last year, the difficulties encountered in the development of the fuel system of the Lance surface-to-surface missile caused us to defer a decision on the future mix of the Lance, Honest John and Sergeant forces. Now, on the basis of several successful test firings, we have decided to proceed with the Lance program and expect to begin initial deployment of the system in the early 1970s.

The Lance missile is being designed as a nuclear weapon system, although it can be readily adapted to carry a conventional warhead if desired at some future time without any modification of the propulsion unit. The deployment of this missile system will permit retirement of most of our older Sergeant and Honest John systems.

Army Air Defense

The Army has been working for some years on an improved version of the Hawk system in order to achieve a faster response time, better electronic countermeasure capability, and much greater reliability. Although the improved Hawk will be more expensive per missile deployed, it will enable us to obtain the capability we need with a smaller force, and at about the same cost. Because of these improvements and the introduction of Chaparral Vulcan, and because of a recent reevaluation of air defense needs, we now plan to reduce the permanent Hawk forces to some extent.

The Chaparral Vulcan force programmed for the FY 1970–74 period is essentially unchanged from last year, except that we now plan an equal number of Chaparral and Vulcan fire units per battalion instead of the heavier emphasis on Vulcan.

The SAM–D, a potential replacement for both the Hercules and Hawk, continues in advanced development.

Marine Corps Division Forces

Overall, there has been no change in the size of the Marine Corps Division forces during the past year. Until the Vietnam conflict is resolved, we will continue to maintain four active divisions and one reserve division. Thereafter, the Marine Corps will return to the pre-Vietnam force structure of three active and one reserve divisions. However, certain additional combat support units will be provided.

Moreover, we have decided to increase the range of Marine Corps artillery by converting the five active and two reserve 155mm gun batteries now in the force to the 175mm gun. The three batteries in Vietnam will be equipped with 175s on loan from the Army by the end of FY 1969. In FY 1970 we plan to procure a sufficient number of these weapons to equip the seven existing batteries plus one new battery which will be added in FY 1971.

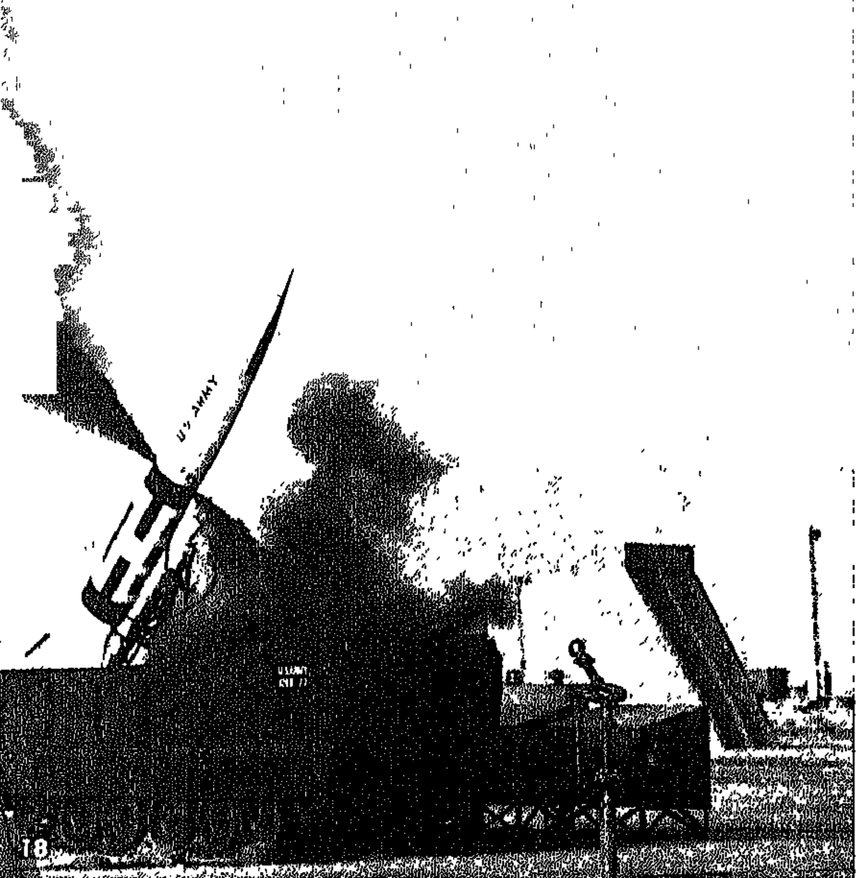
Marine Corps Helicopters

Last year we planned to build up to four medium CH–46 squadrons (21 unit equipment each) and two heavy CH–53 squadrons (24 unit equipment each) in each of the three active Marine Corps wings. In addition, the reserve wing was to be equipped with five medium squadrons of the older UH–34s and one squadron of CH–53s. We now believe this would be more than we need and that it would be better to equip all four wings identically, with a reduced number of squadrons in each wing. These changes reduce the required unit equipment for the helicopter force and will save $70 million in investment costs and $40 million in annual operating costs.

To meet the new force objectives, which will become effective with the end of the conflict in Vietnam, we have increased the procurement and accelerated the deliveries of the CH–53s budgeted in prior years, so as to have six active squadrons, instead of the four active and one reserve squadrons planned last year. All of the UH–34s will be phased out of the forces, first from the active and then from the reserve.

In addition to the medium and heavy helicopters, each wing (active and reserve) will have one mixed light observation squadron.

LANCE SURFACE-TO-SURFACE MISSILE. Initial deployment is expected in the early 1970s. The Lance missile is being designed as a nuclear weapon system, although it can be readily adapted to carry a conventional warhead.



Army Procurement

The FY 1970 Army aircraft procurement program provides for attrition and the continued modernization of the U.S. Army aviation units. To meet these needs, we plan to procure about 1,000 aircraft in the coming fiscal year. Included in the FY 1970 program is the first large procurement of the AH-56A fire support "compound" helicopter. The first 15 aircraft are being bought in FY 1969 as part of a "total package" contract calling for the procurement of 375 AH-56As over a three-year period.

Last year we planned to equip selected M-60 tank units with a mix of 105mm gun and Shillelagh missile/152mm gun systems. In addition, we planned to equip certain armored units with the M-551 Sheridan armored reconnaissance vehicle, which is also armed with the Shillelagh missile/152mm gun system.

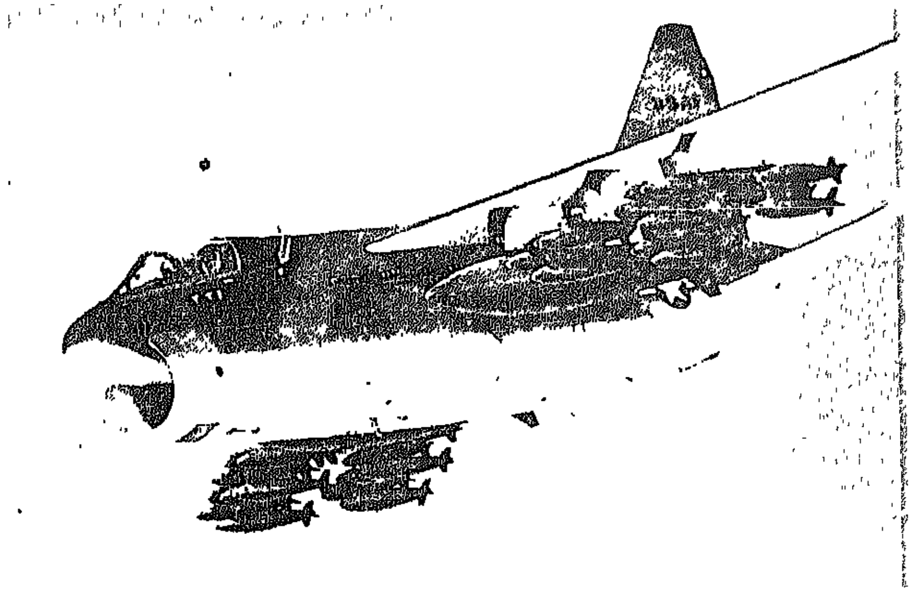
However, as a result of some new technical problems encountered in the Shillelagh/152mm gun turret on the M-60 tank, we have had to modify that program. . . . We now plan to shift our production efforts in FY 1969 and FY 1970 to the 105mm gun M-60. Accordingly, some of the Shillelagh-equipped M-60s included in the FY 1969 procurement program, plus some M-60 chassis which were to be used for other vehicles, will now be configured with the 105mm gun. In FY 1970, we will buy only the 105mm gun M-60s, plus a number of armored vehicle-launched bridges and combat engineer vehicles which use the M-60 chassis. The planned FY 1970 procurements will permit us to maintain the M-60 chassis production line at the minimum sustaining rate.

Aside from the delayed phase-in of the Shillelagh-equipped M-60, the major consequences of the adjustments made in this program will be to increase the number of 105mm gun M-60s in the force over the level previously planned.

The Sheridan armored reconnaissance vehicle has not been affected by the M-60 turret problem since it has a different Shillelagh missile/152mm gun turret. We will continue to buy the Sheridan at the sustaining production rate in FY 1970.

The Main Battle Tank (MBT-70) Program continues to present development problems, making it impossible at this time to fix an initial procurement date. A reassessment of the program is currently under way. Accordingly, we have included in the FY 1970 budget only those funds required to continue research and development and to proceed with limited amount of advanced production engineering.

With respect to anti-tank missiles, funds are included in the FY 1970 budget for the procurement of a large number of TOW missiles, a heavy wire-guided anti-tank weapon which can be used both from ground mounts and by the new AH-56A fire support helicopter. The initial procurement of the new man-carried Dragon medium anti-tank missile has been deferred, pending the results of further testing. The development problems being encountered with Dragon, however, are not considered to be very serious and we fully expect it to perform as designed.



A-7D TACTICAL ATTACK aircraft for close support and other fighter/attack missions. In FY 1970, we propose to buy the first large quantity of A-7s for the Air Force and procurement will continue through 1973.

Tactical Air Forces

For the coming fiscal year we are proposing a total force of about 8,800 aircraft in the General Purpose Tactical Air Forces. The permanent force planned for FY 1974 will be somewhat smaller, but will have a significantly greater payload capacity and a markedly improved reconnaissance and electronic warfare capability.

Active Fighter/Attack Forces

The program proposed for FY 1970-74 provides a total of about 5,000 active fighter/attack aircraft through the duration of the Vietnam conflict and a somewhat smaller permanent force thereafter.

Air Force. As we noted last year, our long-term objective for the fighter/attack force is a balanced capability to meet the full spectrum of foreseeable mission requirements. To provide such a capability we planned a permanent force of 23 wings, consisting of a mix of A-7, F-4, and F-111 aircraft. During the past year we have reassessed the composition of this force and concluded that relatively more emphasis should be given to the close support mission and less to deep interdiction. Accordingly, we now propose a 23-wing force with a mix reflecting an increase in A-7s and F-4s, and a decrease in F-111s.

The F-111 is the only tactical Air Force aircraft with an all-weather, night-time radar bombing system and is extremely well suited for the deep interdiction mission. But it is also less versatile and agile than the F-4, and it costs considerably more than the A-7 which has almost the same payload capability in the

close support role. Consequently, we now believe that the F-111 should be procured primarily for the deep interdiction role, and that for close support and other fighter/attack missions we should rely primarily on the F-4 and A-7. In this way, we can achieve a better balanced and more versatile force at a considerably lower cost.

To offset the slower phase-in of the F-111, made necessary by the Congressional mandate to reduce FY 1969 expenditures, we decided last year to buy some additional F-4s. At the same time, we reduced the planned FY 1968-69 procurement of Air Force A-7s in order to avoid peaking the production rate during the period of rapid buildup of the Navy's A-7 forces, and to help meet our FY 1969 expenditure reduction goal. (The reprogramming requests involved have been approved by the Armed Services and Appropriations Committees.) In FY 1970, when Navy procurement declines, we propose to buy the first large quantity of A-7s for the Air Force, and procurement will continue through 1973. Since our F-4 losses in Southeast Asia are lower than projected as a result of the bombing halt in North Vietnam, the F-4s procured in FY 1969 will meet our needs through December 1971, the normal leadtime for FY 1970 procurement. Accordingly, no F-4s will be procured for the Air Force in FY 1970. However, delivery of F-4s procured in FY 1969 will be stretched through December 1971 so that procurement can be resumed in FY 1971 with no gap in the production line.

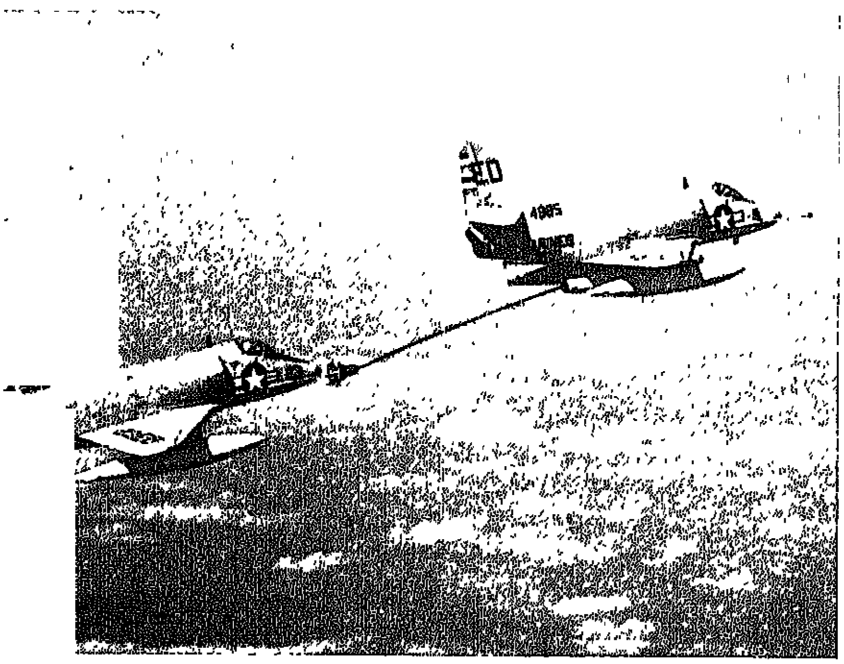
The first squadrons of A-7s will enter the Air Force inventory in FY 1971 and the buildup to the approved force goal will be completed in FY 1974. The buildup of the F-4 force will be completed in FY 1970, and all subsequent procurement will be for attrition.

Two years ago we began the procurement of the A-37B (an attack version of the T-37 [now combat proved]) for the Special Operations Forces in Vietnam. . . . In order to provide the required aircraft, we increased the FY 1968 and FY 1969 buys, and included funds for additional A-37Bs in the FY 1970 budget.

The four F-102 squadrons (three in Pacific and one in Iceland) were scheduled to phase out at the end of FY 1970. However, we now plan to maintain this force through FY 1971, at which time the squadrons in the Pacific will be replaced with F-4s, leaving only the Iceland-based F-102 squadron in the active forces through the program period.

The F-105s will also be retained in the active force longer than planned last year. A lower-than-expected attrition rate will permit us to maintain an additional squadron through FY 1971. In FY 1972 the unit equipment aircraft per squadron will be increased thereby reducing the number of squadrons by two. We presently plan to retain several of these squadrons through FY 1973 to help offset the slower-than-planned phase-in of the A-7.

The 10 Air National Guard squadrons (two F-86 and eight F-100) called up in early 1968 have been or will be returned to reserve status before the end of the current fiscal year. However, we now propose to phase out the remaining 21 active F-100 squadrons at a considerably slower rate than previously planned.



A-4 FOR THE MARINE CORPS. These aircraft will be equipped with a higher thrust engine and a laser device for improved target acquisition and bombing accuracy.

Navy and Marine Corps

Except for the cancellations of the F-111B and the substitution of the VFX-1 (now designated the F-14A), the Navy fighter/attack forces proposed for the FY 1970-74 period are essentially unchanged from last year. We plan to operate approximately 1,650 aircraft with 16 attack carriers (including one CVS serving as a CVA) through the end of the Vietnam conflict. Thereafter, the active forces will be reduced to about 1,350 aircraft and 15 attack carriers.

In order to assist in solving our FY 1969 expenditure problem, we stretched out somewhat the Navy's A-7 production program. We expect to be back on the original schedule by the mid-1970s, when all of the remaining A-4s will be phased out of the active carrier forces. There has been no change in the Navy A-6 force.

Another more important change in the program since last year has been the cancellation of the F-111B and the substitution of the F-14A. Assuming that everything goes according to plan, we would have our first F-14A squadrons in the force by end FY 1973, some two years later than planned for the F-111B.

In order to offset this change in phasing between the F-111B and the F-14A, we propose to retain in the active forces throughout the FY 1971-73 period several more F-4 squadrons than previously planned. A sufficient number of F-8 squadrons will be retained in the force to provide two for each Hancock (Essex)

CVA, since these carriers cannot effectively operate the F–4s.

The Marine Corps active fighter/attack forces are organized in three wings (each with A–4, A–6 and F–4 squadrons) totaling about 600 aircraft, and will be continued through FY 1974. This is the same program presented last year.

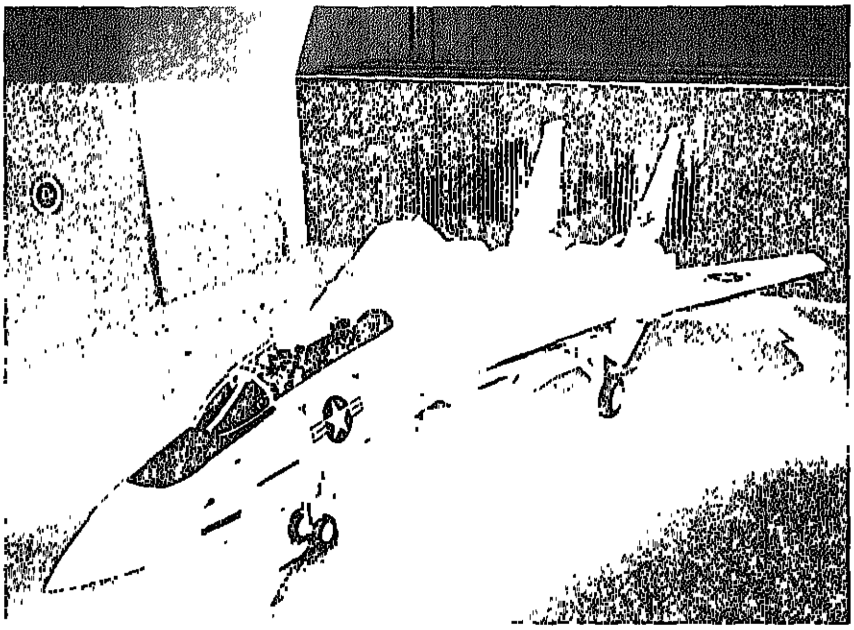
The stretch-out of the Navy A–7 production program, plus the fact that attrition in Southeast Asia is running below the estimate made last year, has enabled us to reduce the original FY 1969 procurement program and to request fewer aircraft than previously planned in the FY 1970 budget. As a result of the stretch-out, however, procurement of A–7s in FY 1971–73 will be higher than planned last year, since some of the aircraft deleted from the FY 1969–70 programs will have to be added to the end of the production run.

We also plan to continue procurement of A–4s for the Marine Corps in FY 1970. These aircraft will be equipped with a higher thrust engine and a laser device for improved target acquisition and bombing accuracy. As indicated last year, we plan to equip the Marines with A–4 aircraft throughout the 1970s . . .

Because we now plan to retain more F–4 squadrons in the Navy, we will have to buy additional aircraft in FY 1970 and continue procurement in subsequent years, instead of making the last buy in FY 1970 as previously planned. Additional A–6s will be procured in FY 1970 and FY 1971 to provide for Navy and Marine Corps normal attrition.

Development of New Fighter/Attack Aircraft

The Navy's new fighter, the F–14, is being designed as an air superiority general purpose fighter, including fleet and area defense. It will fulfill the intended F–111B mission and, eventually, may replace all the F–4s. Designed for high performance, the F–14 will be effective against bombers, other fighters, and anti-ship cruise missiles. By using already developed engines, avionics and air-to-air missiles, the initial F–14, designated the F–14A, should be able to enter the fleet in early 1973. It will provide improved fighter performance and much improved fleet air defense.



NAVY GENERAL PURPOSE FIGHTER. The F–14 is being designed as an air superiority general purpose fighter, including fleet and area defense. It should be able to enter the fleet in early 1973.

When the advanced technology engine of higher thrust but lower weight (currently under joint Navy-Air Force development) becomes available, the Navy version of the engine could go into the second model of the series, which would then be designated the F–14B. A third model of the F–14 series, the F–14C, would incorporate the F–14B's advanced technology engine and an advanced avionics suit, plus the best weapons available for a general purpose fighter. As such, it is expected that this fighter will equal or surpass the best Soviet fighters of the same era.

Contract definition is proceeding on schedule, and development work on the engine and avionics, as well as the Phoenix missile, is continuing. A total of $130 million ($30 million for contract definition, $18 million for the engine, $22 million for the avionics, and $60 million for the airframe) was provided by the Congress last year with the understanding that engineering development of the airframe would not be initiated until 15 days after the Appropriations Committees of both Houses had been notified of the cost and design characteristics of the aircraft selected. A total of $414 million has been included in the FY 1970 budget for the F–14A to continue development and to buy pre-production aircraft for test and evaluation. The buildup to the planned force level needed to fulfill the fleet air defense needs would be completed by the mid-1970s.

In addition to the F–14, we also have under development a new fighter, the F–15 (formerly designated the F–X), for the Air Force. The F–15 is optimized for air-to-air combat with enemy fighters. Its performance will be significantly better than the present F–4E, and it will also be superior to any present or postulated fighter in both close-in visual and long-range missile encounters. The F–15 will have one pilot and twin engines. The engine, as mentioned earlier, is currently under development and utilizes new technology to provide a major increase in thrust relative to weight. The F–15 will be equipped with our most advanced weapons, and combined with good sensors and airframe maneuverability, it will provide a major advance in fighter aircraft.

Based on the current development schedule, the F–15 could be introduced into the Air Force in 1975. To fund this program, $45 million is provided in FY 1969 and $175 million is requested in the FY 1970 budget.

The new Navy and Air Force fighters have a som
design and mission
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signed for air superiority and the fleet air defense role for which it will employ the long-range Phoenix missile. This difference in design makes the F–14A somewhat heavier and more expensive than the F–15, but both will be extremely capable fighter aircraft.

In line with our decision to place more emphasis on the close support mission, we have also included in the FY 1970 research, development test and evaluation budget $12 million for contract definition of a new Air Force attack aircraft designated the AX. We are tentatively planning on a small, twin engine turbo-prop STOL aircraft armed with a new high velocity 25–35mm gun, as well as a wide variety of bombs and rockets. The performance characteristics would emphasize flexibility and maneuverability in flight combined with a good loiter capability.

Reserve Fighter/Attack Forces

In addition to the approximately 5,000 fighter/attack aircraft in the active forces, we now have about 900 in the reserve forces.

Air National Guard. Last year we planned to maintain 28 squadrons of fighter/attack aircraft in the Air National Guard, with 25 unit equipment each. We now plan to convert this force to 24 squadrons with 24 unit equipment each. The 13 squadrons in the force at end FY 1968 simply reflect the fact that 10 squadrons were then on active duty. When the conflict in Vietnam ends we will be in a position to undertake a major modernization of the Guard aircraft inventory. The old F–84s and F–86s will be phased out and replaced with A–37s and additional F–100s. In FY 1974 when the last squadrons of A–7s are delivered to the active force, the remaining F–105 squadrons will be transferred to the Guard. At that time the Guard will have a total of about 680 aircraft, compared with the approximately 565 programmed for end FY 1969.

Navy and Marine Corps. The Navy/Marine Corps Reserve now consists of 20 squadrons with about 355 aircraft (A–4s and F–8s). When the conflict in Vietnam is concluded [illegible] This change will provide a better balance of fighter and attack aircraft in the reserve force. At that point the Navy/Marine Corps Reserve will have 330 aircraft.

Reconnaissance Aircraft

For the reconnaissance mission we plan to maintain the current level of about 800 aircraft for the duration of the Vietnam conflict. Thereafter, the force will be reduced to a somewhat lower level. (The three Air National Guard RF–101 squadrons called to active duty in January 1968 will be returned to reserve status by end FY 1969.)

The major change in the active Air Force from last year is the deferral of the initial procurement of the RF–111D. This aircraft is expected to have twice the range of the RF–4 and should be able to carry a full set of day and night sensors simultaneously. Because of the high unit cost of the RF–111D, however, we have not entirely precluded the use of the RF–4 (with in-flight refueling) for the deep interdiction reconnaissance mission. We will have an opportunity to review this matter before the first RF–111 procurement is actually made.

Although the RF–4 program remains unchanged from last year, we have stretched out the procurement schedule in order to reduce FY 1969 expenditures. The FY 1969 buy was reduced and instead of buying the last increment in FY 1970, we will stretch out procurement through FY 1971.

The Navy reconnaissance program is the same as that presented last year. Additional RA–5s will be procured in FY 1970 to maintain that force at the planned level through FY 1974. The RA–3s will be phased out in the next few years.

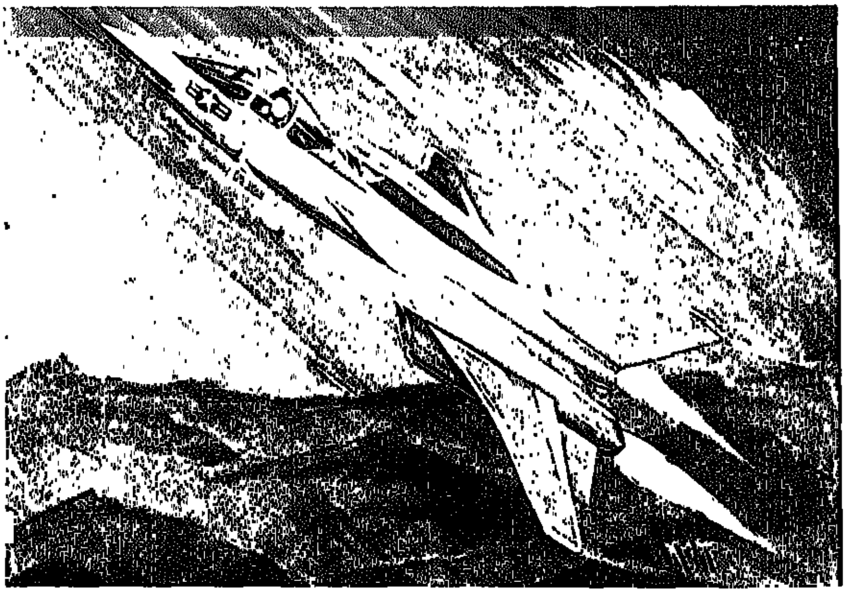
The Marine Corps force of RF–4s will be maintained at the current level through the program period.

Most of the reserve reconnaissance aircraft are assigned to the Air National Guard where some 200 aircraft are organized in 12 squadrons. As additional RF–101s become available from the active forces and through conversion of F–101s, the number of RF–84s in the Guard will be reduced. By end FY 1974 the Guard reconnaissance force will consist of seven squadrons of RF–101s, three RF–84s and two RB–57s.

Other Aircraft

In addition to the fighter/attack and reconnaissance types, the tactical air forces now include about 2,000 "Other" aircraft—special operations, electronic and night warfare, tactical air control, airborne early warning, etc. The Special Operations Forces (SOF) and Tactical Air Control (TAC) forces account for about 70 percent of the total. When the Vietnam conflict ends, this "Other" category will be reduced.

OPTIMIZED FOR AIR-TO-AIR COMBAT. Under development, the F–15 will be superior to any present or postulated fighter in both close-in visual and long-range missile encounters.



NAVY RECONNAISSANCE AIRCRAFT. Additional RA–5s will be procured in FY 1970

Special Operations Forces. At end FY 1969, the SOF will have well over a dozen different types of aircraft. With the end of the Vietnam conflict, the active force will be reduced in numbers and will have only five types—A–37, C–123, C–130, UH–1, U–10. The SOF complement in the Air National Guard will be continued as presently constituted.

Tactical Air Control. With the end of the Vietnam conflict the Air Force tactical air control forces will be reduced to about one-half of its present aircraft strength. Included in the active force will be OV–10s, O–2As and helicopters.

In FY 1971 the TA–4s in the Marine Corps tactical air control units will be replaced with the O–2 which is much less expensive to operate.

The production of O–2As has been greatly increased in the last year. The FY 1968 buy was increased from 92 to 253, and we are buying 69 more in FY 1969. Funds are included in the FY 1970 budget for the procurement of the final increment of these aircraft for the Air Force and the Marines.

Electronic Warfare. The principal issue in this area for the last several years has concerned the development and procurement of the EA–6B. As noted last year, the cost of this aircraft has risen throughout the development period and the delivery date has been repeatedly slipped. Now, however, the project has reached a stage where we can start production. The FY 1970 budget includes $248 million for the procurement of the first increment of operational aircraft; the remaining aircraft are tentatively scheduled for procurement in FY 1971 This is the same program planned last year.

Miscellaneous. The most important change in this category concerns the reequipping of the Navy tanker force. We now propose to replace the present force of KA–3s, which are nearing the end of their useful life, with the KA–6D. . . . The FY 1970 budget includes $58 million for the first increment of operational aircraft. The remaining aircraft will be procured in FY 1971–72.

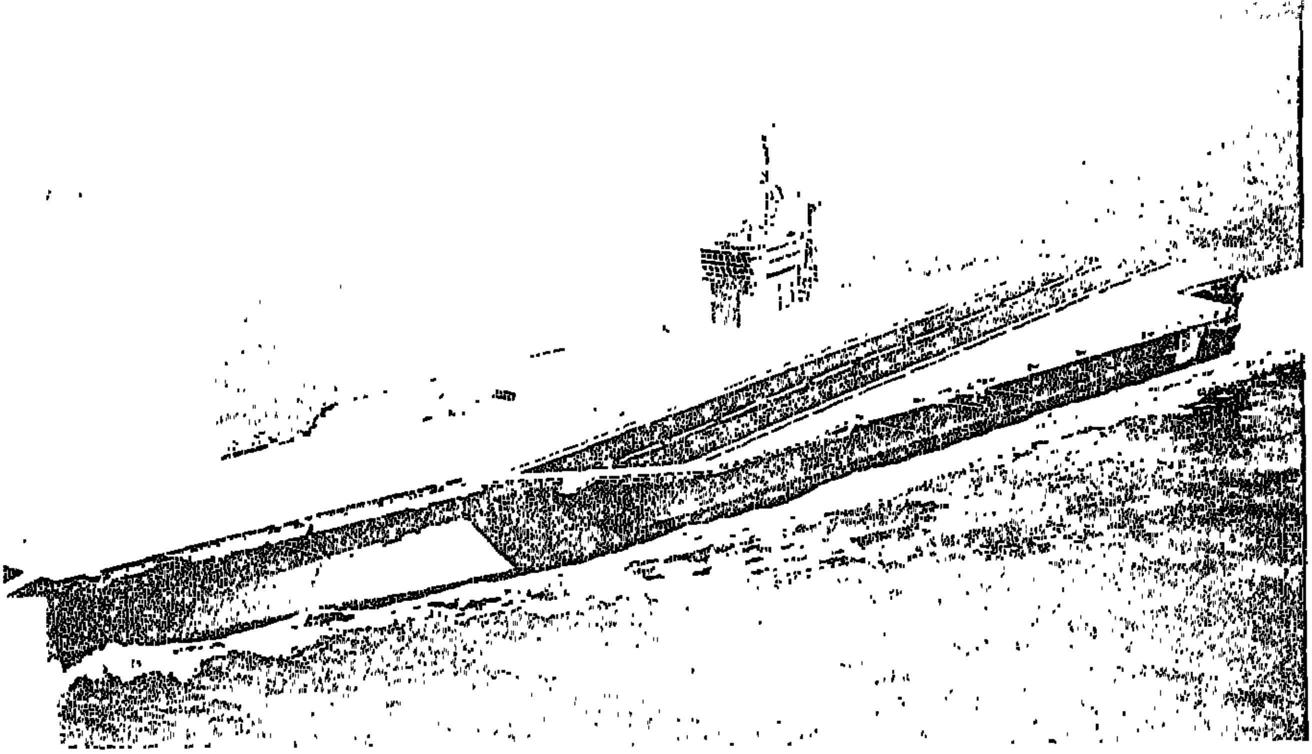
Sea Forces

Included under this heading are all of the Navy General Purpose Forces, except tactical aircraft which were discussed in the preceding section (together with those of the Air Force and Marine Corps). The major issues involved in this program concern the anti-submarine warfare forces, the amphibious assault fleet, and the mix of nuclear and conventionally-powered escorts for the four planned nuclear-powered attack carriers.

Attack Carrier Forces

Despite a temporary augmentation for the duration of the Vietnam conflict, our long-range goal of 15 attack carriers (CVAs) remains unchanged. We now plan to maintain the current force level, 15 active attack carriers plus one anti-submarine carrier (CVS) temporarily serving in the Pacific as a CVA, through FY 1970. At the end of that fiscal year, the force will consist of one nuclear-powered carrier (CVAN), the Enterprise; eight conventionally-powered Forrestal-class carriers (including the John F. Kennedy); three Midway-class carriers; three Hancock (Essex)-class carriers; and the Shangri-La, which will become a CVS at the end of the Vietnam conflict. (The Midway is expected to finish its lengthy modernization and conversion and rejoin the fleet in FY 1970, releasing one of the Hancock (Essex)-class carriers for the CVS force.)

As noted last year, the CVA force at the end of FY 1976 will consist of four nuclear-powered CVANs, eight conventionally-powered Forrestal-class CVAs and three Midway-class CVAs. All of the old Hancock (Essex)-class World War II vintage carriers will then have been trans-



NUCLEAR-POWERED CARRIER Chester W. Nimitz (CVAN-68) is scheduled to join the fleet in FY 1972. The FY 1970 budget includes $377 million to complete funding of the third nuclear-powered carrier, CVAN-69.

ferred from the CVA to the CVS force.

The nuclear-powered Chester W. Nimitz (CVAN-68) is scheduled to join the fleet in FY 1972. It will cost $536 million, about twice as much as the conventionally-powered John F. Kennedy which cost $277 million. The FY 1970 budget includes $377 million to complete the funding of the third nuclear-powered carrier (CVAN-69). Together with the $51 million provided for FY 1967-68 and $82 million for FY 1969, the total cost of this ship is now estimated at $510 million, $26 million less than the Nimitz. This difference in cost reflects the fact that CVAN-69 is being built on the same contract and design plans as the Nimitz. CVAN-69 should enter the fleet sometime in FY 1974. The fourth nuclear-powered carrier (CVAN-70), which will also be identical to the Nimitz, will be funded in FY 1971.

Last year we planned to start the modernization of the Franklin D. Roosevelt in FY 1970. However, the modernization of her sister ship, the Midway, is taking so much longer and is costing so much more than originally estimated (24 months and $88 million vs. 48 months and $178 million) that we have now decided not to modernize the Roosevelt. Since the FDR will complete an austere overhaul by June 30, 1969, which will enable it to handle the new A-6s and A-7s, the need for a complete modernization has been partially alleviated.

Anti-Submarine Warfare (ASW) Forces

The ASW forces include both ships and aircraft.

ASW Carriers. The present CVS force, as we have pointed out in past years, is costly to operate in relationship to its effectiveness, particularly against the newer Soviet nuclear-powered submarines. If the CVS force is to be retained through the 1970s' its capability to detect, locate and destroy hostile submarines must be considerably improved. It was for this reason that we decided last year to go ahead with the development of a new ASW aircraft, the VSX, and eventually to modernize the existing carriers. One of the unique purposes a CVS force can serve is to provide a capability to extend ASW air operations rapidly into areas which cannot now be covered by the land-based P-3s. It would also provide a hedge against the possible loss of our present ASW air bases in Europe and Asia.

Last year we planned to phase down the CVS fleet to five ships and four air groups at the conclusion of the Vietnam conflict. However, in view of the accumulating evidence that the Soviets are improving their submarine forces, we now plan to maintain a force level somewhat higher than this through the FY 1970-74 period. One CVS will continue to operate as a CVA, returning to its ASW role after the conflict in Southeast Asia is terminated. We plan to modernize two of the existing CVSs (one in FY 1972 and one in FY 1974) and to replace three of them with Hancock (Essex)-class carriers as they are phased out of the CVA force.

The VSX development program is proceeding on schedule. Contract definition was initiated last August and completed in December 1968. The Navy should be ready to contract for engineering development in February or March 1969. The first flight is scheduled in the early 1970s and the initial increment of operational aircraft should be delivered to the fleet sometime thereafter. Funds have been included in the FY 1970 budget

for the first year of full-scale development.

Procurement of the VSX is scheduled to begin in the early 1970s and continue for several years. Each CVS will eventually carry the VSX. In the meantime the S-2 force is being phased down in balance with the reduction of CVSs. When the first VSX squadrons are delivered, the S-2 force will be reduced accordingly.

In addition to the VSX, each CVS will continue to carry a complement of ASW helicopters, A-4s for a limited intercept and air defense capability, and E-1s for the airborne warning and control mission.

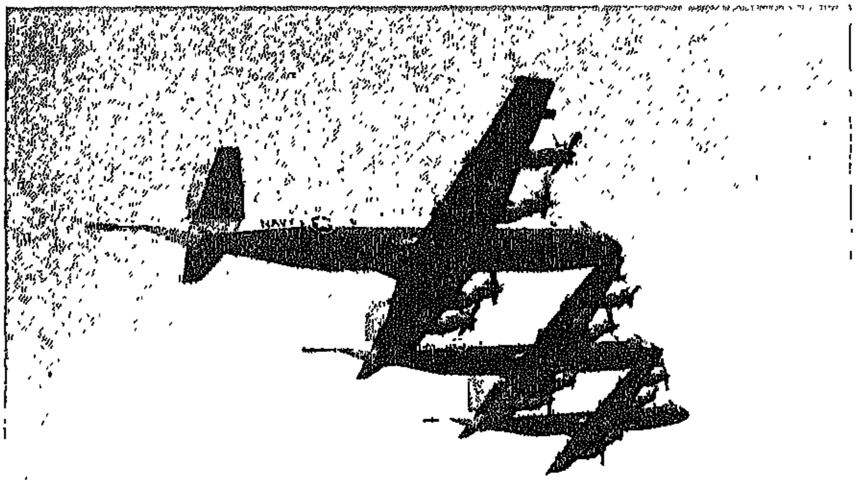
Patrol Aircraft. Last year we planned to phase down the patrol aircraft force as the more effective P-3C land-based and VSX carrier-based ASW aircraft became available. However, in view of the expected growth in the Soviet submarine threat, we now plan to maintain the force at a higher level and buy enough additional P-3s to complete the equipping of the entire force. To do so, we will have to buy additional aircraft beyond the number previously programmed. Included in the FY 1970 budget is $237 million for a substantial number of complete aircraft and long leadtime items for an additional quantity to be procured in FY 1971.

When this force modernization is completed, a sizable proportion of these squadrons will be equipped with the newer P-3Cs and the balance with P-3A/Bs. The P-3C will have the more capable A-NEW avionics system which will provide much faster, automated processing of information received from the aircraft's radar and sonobuoys. All of the P-3s, however, will be capable of using the DIFAR sonobuoy now under development, as well as the new MK-46 torpedo.

Attack Submarines. The attack submarine force presented last year included 60 "first line" SSNs. A total of 66 SSNs had been funded through FY 1968, of which one had been lost (Thresher) and nine were no longer considered "first line" (although they could be used for other purposes), leaving 56 SSNs available for the "first line" mission. On this basis, only four more SSNs were considered necessary; two were programmed in FY 1969 and two in FY 1970. (Another "first line" SSN (Scorpion) was lost last May.)

Now, in the light of the anticipated increase in the Soviet submarine threat, we believe that our SSN force goal must be reassessed both quantitatively and qualitatively. More and better attack submarines may be required in the mid- and late 1970s than we had previously thought necessary. Moreover, the only practical way we now see to preserve our design and production capabilities is to continue to build some new submarines and to introduce advanced types periodically.

PATROL AIRCRAFT. In view of the expected growth in the Soviet submarine threat, we now plan to buy enough additional P-3s to complete equipping of the entire force.



Accordingly, we now propose to start during the program period a substantial number of new type attack submarines. Some will be of a new design emphasizing speed, and others of a new design to be based on Navy studies aimed at producing an optimum set of characteristics, including speed and quietness. Both are highly desirable characteristics in attack submarines, but they are to some extent mutually exclusive, and must be traded off in any given design. Very quiet and very fast submarines can, however, make useful contributions to an operating force, and that is the concept underlying our decision to build different types of attack submarines.

As tentatively scheduled, the first three "high speed" (SSN-688-class) submarines would be started in FY 1970 at an estimated cost of $536 million. Several more would be started in FY 1971 and the remainder in FY 1972. By that time, the new design ("CONFORM") submarine should be ready for construction.

Work on the Turbine Electric-Drive Submarine (TEDS), funded in the FY 1968 program, is going forward as planned, but its estimated cost has risen from about $100 million to about $152 million, and it may go as high as $200 million. Nevertheless, we believe TEDS will be worth its cost since it will provide us unique and valuable operational and test experience with this new type of propulsion plant and other important quieting features considerably earlier than could otherwise be achieved.

Because of the loss of the Scorpion, the retirement of the Triton (an older SSN), and the expected delay in the delivery of one new SSN, the nuclear-powered attack submarine force at end FY 1969 will number 41 instead of 44. And, because of the need to reduce FY 1969 expenditures, we chose not to retain three additional conventional submarines. Accordingly, the attack submarine force at end FY 1969 will number 102 instead of the previously planned 105. By end FY 1970, we expect the force to be back up to the 105 level (47 nuclear, 58 conventional), and we plan to keep it there by retaining a sufficient number of conventionally-powered submarines through the program period.

Escort Ships. Last year we presented a comprehensive analysis of

our escort requirement for the late 1970s. Except for the increase of eight ships (four with anti-air warfare (AAW)/ASW and four with ASW only) necessitated by the retention of one more CVS, the overall requirement remains the same—231 plus 8, or a new total of 239.

In the intervening year, however, the estimated cost of the shipbuilding program (68 new ships) proposed to meet this requirement has risen from about $3 billion to around $5 billion. The estimated cost of the DX program proposed last year has grown from $1,364 million to $2,270 million, the DXG from $1,154 million to $2,032 million, and the DXGN from about $500 million to $768 million. Much of this increase in estimated cost is basically the result of two factors—a continuing rise in the price of labor and materials and more realistic estimates based on later contract information.

In view of these cost increases we have had to review our original plan for meeting the escort ship requirement. As a result, we now propose to reduce the DX program, pending an evaluation of actual ship capabilities and costs. However, we will have to increase the DXG program in order to provide four more AAW-capable ships for the additional CVS. Thus, the revised shipbuilding program will total 62 ships.

In addition, we have had to reduce the FY 1968 DE construction program from four to one (it had originally been 10 ships) in order to finance cost overruns on the two FY 1968 SSNs and to comply with the Congressional mandate to reduce FY 1969 expenditures. The net result of these changes in requirements and in the shipbuilding program is that we will have to retain in the force 17 more of the older escorts than we had previously planned.

We have again examined the mix of nuclear-powered and conventionally-powered escorts for the four planned CVANs and have reached the same conclusion as last year, namely, that we should provide nuclear-powered escorts for only two of the CVANs. This would require a total of nine nuclear escorts (eight in operation, one in overhaul), five of which have been funded. If we were to provide nuclear escorts for the third and fourth CVANs, we would have to increase the inventory of nuclear escorts by seven and decrease the inventory of conventional escorts by nine. The manner in which these changes are calculated is shown in Figure 2.

The seven additional nuclear escorts required to equip four (rather than two) all-nuclear task groups would cost about $1.6 billion to build and operate for 10 years. These would replace nine conventional ships with a comparable 10-year systems cost of $1.1 billion. The difference of $500 million in favor of conventional escorts would be partially offset by about $75–$80 million in logistics savings, leaving a net additional cost for the third and fourth all-nuclear carrier task groups of about $420–$425 million. There are also a number of hard-to-measure operational advantages to nuclear power, but these do not appear to be worth the more than $400 million involved. Accordingly, we do not believe it would be wise to commit ourselves at this time to more than two nuclear-powered carrier task groups.

The number of ASW escorts will drop in FY 1969, reflecting the earlier than planned phase-out of older ships necessitated by the expenditure reduction program.

The proposed escort shipbuilding program is spread over a period of six years, FY 1970–75. Inasmuch as the funds requested for five DXs in FY 1969 were denied (except for $25 million for long leadtime procurement), we have rescheduled the program. The FY 1970 budget now includes $335 million for the first five ships and advance procurement for the next eight.

The funds requested in FY 1969 for contract definition of the DXG were also denied on the grounds that this ship would not be ready for contract definition in that year. We expect to commence DXG contract definition in FY 1970, funds for which have now been included in the FY 1970 budget. Construction of the first increment of DXGs would start in FY 1971, followed by additional ships in each year through FY 1975.

The DXGNs are now programmed one a year, FY 1972–73. The first ship is expected to cost $222 million, and the follow-on ships an average of $180–$190 million. Advance

Total CVA/CVAN Escorts Required

	Carrier Task Groups	Carrier Escorts (AAW/ASW)		
Option	On Line (80 percent of Carrier Inventory)	On Line (85 percent of Inventory)	Inventory	Change in Inventory
Two All-Nuclear				
Nuclear	2	8	9	—
Conventional[a]	10	60	70	—
Total	12			
Four All-Nuclear				
Nuclear	3.2[b]	12.8	16[c]	+7
Conventional	8.8	52.8	61	−9
Total	12			

[a] Conventional escorts with CVA or CVAN.

[b] Four CVANs, with a 20 percent overhaul factor, provide three on line 80 percent of the time, and four on line 20 percent of the time. For purposes of computation, this is expressed as 3.2 CVANs on line. This same shorthand device is used for escorts on line.

average of 15 nuclear escorts is required in inventory. Howor the 20 percent of the time that four CVANs are on line, 16 needed. Buying the sixteenth nuclear escort will provide, on the s, one excess missile ship, which reduces the DXGs needed from 0.

Figure 2.

procurement funds in the amount of $52 million were made available in FY 1969 for the first two ships. The FY 1970 budget includes $196 million to complete funding of the first DXGN and $68 million for advance procurement for additional ships. (The $68 million will complete the funding of nuclear components for all four DXGNs and fire control systems for the first three, thus permitting us to meet the delivery schedules contemplated last year.)

The missile ship modernization program is the same as that described a year ago. Two DLG–6–class ships are to be modernized in FY 1970, at a cost of $72 million, and five more are scheduled for the FY 1971–73 period. One DLG–16–class ship is to be modernized in FY 1970, at a cost of $33 million, and two more are planned in FY 1971. The FY 1970 budget includes $70 million for the three conversions ($35 million was provided for advance procurement in FY 1969) and $49 million for long leadtime items for the ships to be converted in FY 1971.

The five DD–931/945 conversions previously scheduled for FY 1970–1971 have been cancelled. The estimated cost of converting these ships has risen substantially since they were originally programmed, and the increased capability is not worth the added cost. The eight conversions of this ship class which were authorized and funded in FY 1967 and FY 1968 will be completed as planned.

Funds are included in FY 1970 to continue the installation of the Basic Point Defense Surface Missile System (BPDSMS) in a variety of existing and new ships. Development is proceeding on an advanced version of this system with increased firepower and effectiveness.

We are also planning continued procurement in FY 1970 of the extended-range and medium-range Standard surface-to-air missiles, the new missiles which are fired by Terrier and Tartar missile escorts, respectively. A new ship air defense system, the Advanced Surface Missile System (ASMS) is now in contract definition. This system is being designed as a follow-on for Tartar and Terrier in new construction or modernized escorts.

Sonobuoys. The effectiveness of ASW aircraft is critically dependent on the availability of sensitive and accurate sonobuoys. A new sonobuoy system (DIFAR) has been developed and placed in production. The first procurement was made last year, and fleet testing and evaluation will be completed in the next fiscal year. The FY 1970 request provides for the procurement of additional DIFAR as well as Jezebel/Julie sonobuoys.

We are also requesting funds to complete development of an improved version of the SSQ–47 sonobuoy. Even more advanced acoustic sensors are under development and these should further improve our capability to detect the newer Soviet submarines.

Torpedoes. The availability of modern, fast torpedoes with sufficient acquisition range is another important determinant of the ASW capability of our aircraft, escorts and SSNs.

Production of the latest surface ship/air-launched ASW torpedo, the MK–46, is continuing. Funds are included in the FY 1970 budget for procurement of an additional quantity of these torpedoes.

Development of a new submarine-launched ASW torpedo (the MK–48–0), which will have greatly increased capability over the MK–37 which it replaces, has been underway since 1964. Although this program is still encountering technical problems, we believe the solutions are now within reach. Accordingly, we intend to procure an initial increment of operational MK–48s in the coming year with the $118 million included in the FY 1970 budget for this purpose. We are also developing another version of this torpedo, the MK–48–1 for use against surface ships. The FY 1970 budget provides for further development work on both versions of the MK–48.

Amphibious Assault, Fire Support and Mine Countermeasure Forces

The amphibious assault ship force planned last year included enough fast (20-knot) modern ships to move one Marine Expeditionary Force (MEF), *i.e.*, division/wing team, in the Pacific and one-half in the Atlantic. Older, slower ships were to be retained to provide lift for the other half of the Atlantic MEF.

In view of the importance of quick response we now feel that we would be better advised to maintain a somewhat smaller amphibious lift, but one composed entirely of fast ships. To this end, we have revised the program to provide a 20-knot lift for 1⅔ MEFs—one in the Pacific and two-thirds in the Atlantic. However, with a delay of comparatively few days, a predesignated group of amphibious ships in the Pacific would be able to join those normally deployed in the Atlantic to provide lift for a complete Marine Expeditionary Force, if one should ever be needed there. This plan would provide a somewhat smaller but faster amphibious lift than the one proposed last year, and the 10-year systems cost would be about $1 billion less.

Another important factor in the size and cost of the amphibious lift is the manner in which the ground support for the air element is to be transported. Previously, we had planned to carry the men and equipment associated with two of the three prefabricated airfields (Short Airfields for Tactical Support, known as SATS) per MEF in the amphibious ships of the Assault Echelon. We now plan to transport all three SATSs in the MSTS-controlled ships of the Assault Follow-on Echelon, which is scheduled to arrive about five days after the landing. Since the Assault Echelon must depend upon the attack carriers for close air support during the landing and while the SATSs are being installed and made operable, this arrangement would simply extend that period by about five days. The currently planned attack carrier forces are clearly adequate to meet this small additional requirement. Thus, we can save about $600 million in 10-year systems costs, without detracting from the required air support.

Amphibious Assault Ships. In view of the foregoing changes in concepts, we now plan to construct a greater number of large general purpose assault ships (LHAs) than we planned last year, and to phase out more of the older, slower amphibious ships than previously planned. (We will also have to retain in the Sealift Forces some more MSTS troop ships to move the additional SATS personnel now included in the Assault Follow-on Echelon.)

The amphibious command ship (LCC) which had been planned for FY 1970 has been cancelled. This ship would be needed only for a full MEF lift in the Atlantic as

well as the Pacific. (Two LCCs are available for the Pacific MEF.) We are also deferring conversion of a second Regulus submarine for the mission of surveying assault beaches and landing reconnaissance and demolition teams, previously planned for FY 1970. Originally estimated at $22 million, the cost is now about $30 million, and we are deferring this conversion for the time being in the hope that a lower-cost solution can be found.

Contract definition on the LHA has been completed, and the Navy will soon award a multi-year contract for the development and production of the programmed ships, including the ship funded in FY 1969. It is now clear, however, that the cost of the LHA will be substantially higher than expected. A year ago we estimated that the lead ship would cost $153 million and the follow-on ships an adjusted average of $122 million. We now estimate that these costs will be about $185 million and $140 million, respectively. Consequently, we now propose to procure two ships in FY 1970 instead of the three planned a year ago. The FY 1970 budget includes $288 million for these two ships (the second and third) and long leadtime items for two more to be started in FY 1971. Of the $63 million provided in FY 1969 for advanced procurement, $32 million will be used to complete the funding of the lead ship approved last year, $17 million will be used for long leadtime items for the next two ships, and the balance of $14 million will be applied against the FY 1970 shipbuilding requirements, generally. The remaining LHAs are programmed in FY 1972–73.

In addition to the LHAs, we will still need the seven LSTs programmed last year for FY 1970. However, we now propose to start them in FY 1971.

When the new ships have been delivered, the active amphibious assault fleet will consist of all fast, modern ships. In addition, an adequate number of older ships will be kept in the Category BRAVO Reserve for rapid activation in case a capability to lift two full MEFs simultaneously is ever required.

Fire Support Ships. The fire support force now includes 8-inch gun cruisers, rocket ships, and a reactivated battleship. We also have in the escort category AAW cruisers with 6-inch guns and a large number of 5-inch gun destroyers which can be used effectively for gunfire support, as in Southeast Asia.

The Navy is currently engaged in concept formulation of a new type of ship to provide major caliber gunfire support for the amphibious assault forces. However, this new Landing Force Support Ship (LFS) will not be ready for contract definition in FY 1969, and we now tentatively plan to construct some of these ships during the FY 1971–73 period.

Mine Countermeasure Forces. The programmed mine countermeasure force is little changed from last year. The major effort begun two years ago to rehabilitate the 63 existing MSOs will continue at the same rate of 10 per year until the program is completed. The FY 1970 budget request includes $48 million for 10 MSO conversions and advance procurement for 10 more.

The $139 million provided in FY 1966–68 for the construction of 16 new MSOs is no longer available, since $43 million was reprogrammed to the DLGN program and the remaining $96 million was rescinded by the Congress in FY 1969. The 16 MSOs are still required, and we now tentatively plan to construct them in the FY 1971–73 period.

To complete the modernization of the mine countermeasure forces, we now plan to build two new helicopter-carrying mine countermeasure support ships (MCSs), one in FY 1971 and one in FY 1972. (We had previously planned to start these ships in FY 1970–71 but concept formulation is not far enough along to do so.) One of the three existing MCSs, a ship of limited capability and scheduled for retirement in FY 1973, was retired in FY 1969 as an expenditure reduction measure. When the ships programmed for FY 1971–1972 are completed, the force will consist of four MCSs (two new ones and two older ships equipped with minesweeping launches).

Logistic, Operational Support, and Direct Support Ships

A force of 217 Underway Replenishment, Fleet Support, Special Combat and Small Patrol vessels is planned at the end of FY 1969, and 222 at end FY 1970. There will be four less in FY 1969 than previously planned, since the fourth new combination oiler-ammunition ship (AOE) will not be delivered on schedule, and three older ships are being phased out early as an expenditure reduction action. By end FY 1974, the force will decline to 204 as older ships are phased out and replaced on a less than one-for-one basis and as a part of the active Underway Replenishment (UNREP) fleet is transferred to the Category "B" Reserve.

Analysis of future UNREP requirements shows that, after the conflict in Vietnam is terminated, we can reduce the number of these ships in the active fleet and still meet our contingency requirements, providing all forward bases remain available. To hedge against the possibility that some of these bases may be lost, we propose to maintain more than the calculated number of these ships in the active force, and additional ships in the Category "B" Reserve.

In the Fleet Support category, the destroyer tender (AD) previously planned for construction in FY 1970 has been deferred to FY 1971. The FY 1970 budget provides for this category only two fleet salvage tugs (ATS) at a cost of $45 million. To modernize the logistic and support ship force, we have tentatively programmed about $1.7 billion in the FY 1971–74 period for new construction.

Navy Reserve Forces

The Navy will continue to maintain a force of ASW carrier-based aircraft and helicopters in the Reserve through FY 1974, which would be more than adequate to equip the four CVSs that will be maintained in the Category "B" Reserve. A number of P-2 land-based patrol aircraft will also be maintained in the Reserve through FY 1974.

The ready Naval Reserve Training (NRT) fleet will increase from 77 ships at end FY 1969 to about 88 ships by FY 1974, including 22 MSCs and 37 ASW escorts. In addition, a large number of ships will continue to be maintained in the inactive Categories "B" and "C".

Airlift and Sealift

The Airlift and Sealift Program comprises: the Military Airlift Command's strategic airlift aircraft; the Air Force's tactical airlift aircraft assigned to the Tactical Air Command and the Unified Commands; the transport and tactical airlift aircraft in the reserve components of all the Services; certain cargo and transport aircraft of the Navy and Marine Corps; specialized transportation forces such as aeromedical airlift units and aerial port squadrons; and the troop ships, cargo ships, tankers and "Forward Floating Depot" ships operated by the Military Sea Transportation Service. These forces, when augmented with the resources of commercial air and sealift in emergencies, combine to provide the total lift needed to meet defense requirements.

Requirements for Strategic and Tactical Lift

A year ago we presented a comprehensive analysis of the requirements for strategic airlift and sealift to move men and equipment overseas, and for tactical airlift to support operations in the combat theater.

As noted in the preceding section of this statement, our General Purpose Forces are sized to meet simultaneously the more probable contingencies. Our strategic lift forces are designed to provide the capability to move the required forces rapidly. Last year we found that the rapid response capability needed could be provided at least cost by a force consisting of: 6 C–5A squadrons, 14 C–141 squadrons and 30 Fast Deployment Logistic (FDL) ships; prepositioned materiel in Europe and in the Pacific and selected non-divisional support units; a Civil Reserve Air Fleet (CRAF) equal to 465 B–707/DC–8s; and the equivalent of 460 "notional" commercial cargo ships.

While our estimate of the strategic lift requirement has not changed during the past year, two major problems have arisen which have caused us to reexamine the composition of the force. First, it is now clear that the C–5A will cost us considerably more than previously estimated, and we may have to reconsider the ultimate size of that force. Second, our inability to date to win Congressional support for the proposed FDL program has forced us to examine alternative approaches, since our sealift capability is now lagging seriously behind our improved airlift capability. Both of these issues are discussed in greater detail later in this section of the statement.

Our analysis of the tactical airlift requirement is, also, basically the same as that described a year ago. We estimate that the 14 planned C–130E squadrons would be more than sufficient to meet the tactical airlift needs of a major contingency in Asia and a minor contingency elsewhere, as well as to provide a rotational base for the training of airlift crews. Estimates of the requirements of a major European contingency vary widely. We expect to have through the mid-1970s a substantial number of C–130s and KC–130s in the active and reserve forces. These aircraft, together with the C–123s and C–7s, should be more than adequate to meet the European tactical airlift requirement. As to the future, we are continuing our studies of a new intra-theater transport which could give us an improved STOL or V/STOL capability.

Airlift

Active Air Force Airlift

The major issue here, as noted earlier, concerns the C–5A program. A year ago we planned to buy a total of 120 aircraft, at a cost of about $3,620 million (including about $330 million for initial spares), to equip six squadrons (96 unit equipment aircraft), provide for command support, attrition and training. Late last year, it became increasingly apparent that the cost of this program would run considerably higher than previously estimated, perhaps as much as $4,830 million (including about $1 billion for research and development and $482 million for initial spares).

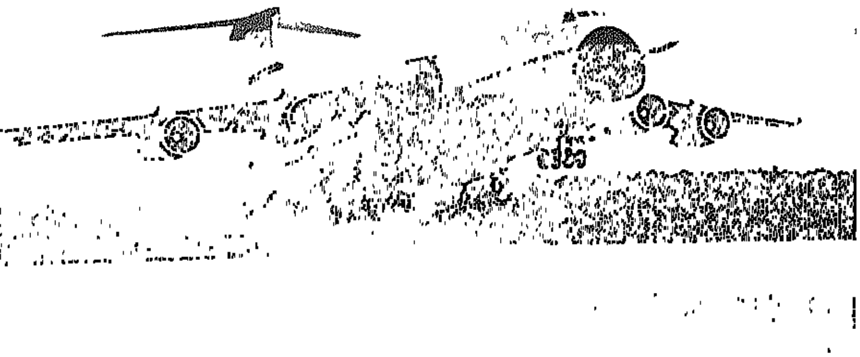
We are presently committed to procure only 58 aircraft (including five research and development aircraft, all of which can be made available for operational use). This quantity is enough to equip three squadrons (48 unit equipment), and provide for command support and training.

In view of these very substantial increases in estimated costs, most of which are on the Lockheed contract, we are taking the following steps:

- Although we will exercise our option on the 57 aircraft in Run B, we will limit the Government's liability to 23 aircraft in FY 1970 instead of the 33 we had previously planned; these 23 aircraft will bring the total number on order to 81, enough for a full four-squadron force (64 unit equipment).
- We will make separate decisions at a later date on the aircraft for the fifth and sixth squadrons. So long as these decisions are made before the leadtime on those squadrons, our contract with Lockheed will allow us to decide in the negative without increasing the price to the Government of the first four squadrons.
- The concept of reserve associate squadrons now underway in the C–141 force will be applied to the C–5 to increase the overall wartime productivity of our active airlift force.

We have included in the FY 1970 budget a total of $1,002 million—$34 million for research, development, test and evaluation, $505 million for the procurement of 23 aircraft ($577 million, less $72 million in advance procurement funds provided in FY 1969), $28 million in advance procurement funds for a possible FY 1971 buy, $225 million to fund prior years over target costs, and $210 million for initial spares. Of the $1,002 million requested for FY 1970, $334 million is required to complete the funding of the first three squadrons —$34 million for research, development, test and evaluation, $225 million to fund prior year over target costs, and $75 million for initial spares.

The C–141 force reached its projected strength of 14 squadrons by



C–5A GALAXY. We are presently committed to procure only 58 aircraft, enough to equip three squadrons and provide for command support and training. We will exercise our option on 57 aircraft in run B; we will limit the Government's liability to 23 aircraft in FY 1970, bringing the total number to 81, enough for four squadrons.

the end of FY 1968. The authorized active inventory has been raised slightly in FY 1969 to offset a reduction in inter-theater capability caused by the early transfer of two C–130E squadrons from the Military Airlift Command to Tactical Air Command.

As a hedge against any slippage in the C–5A program, we plan to retain some of the current outsize airlift capability. Three C–124 squadrons will be retained through FY 1970. Three C–133 squadrons will be retained through FY 1970 and two through FY 1971.

Our analysis shows that the C–130 force programmed for FY 1973–74, 14 C–130E squadrons and one squadron of ski-equipped C–130Ds, will provide an adequate tactical airlift capability in the active forces. However, C–130E attrition has been running higher than estimated last year, and additional aircraft will have to be procured to maintain the desired force levels. We plan to procure 18 C–130Es with the FY 1968 funds provided for this purpose by the Congress, and 18 more are being pro- nine Air National Guard units. The C–130Bs will be used to form four Reserve and four Guard units.

Concept formulation is continuing on a new Light Intra-theater Transport (LIT), which could enter the tactical airlift force in the mid- to late 1970s. This effort has been expanded to include consideration of both STOL and V/STOL aircraft, and the evaluation will now take more time than we had originally thought necessary. Consequently, we do not plan to initiate LIT contract definition until FY 1971.

Air Force Reserve Component Airlift

All of the 40 groups which made up the Air Force Reserve (AFR) airlift force in FY 1968 will be retained through FY 1969, as desired by the Congress. Three of the four C–119 units previously scheduled for deactivation in FY 1969 will be retained in the force structure and converted to Tactical Air Support squadrons to provide Forward Air Controllers and Air Liaison Officers for the eight Army Reserve component divisions. The fourth unit was activated in May, converted to the AC–119 (gunship) and deployed to South Vietnam. It will leave its aircraft there on its return and revert to Reserve status by end FY 1969, at which time it will be assigned the same or another mission.

The C–141 "associate" unit concept described to the Congress last year has been tested and shown to be a most effective way to increase our airlift capability. . . . Five C–119 squadrons are being converted to C–141 associate units in FY 1969, and six more C–141 associate units (four conversions and two new units) will be created in FY 1970.

By end FY 1970, eight Air Force Reserve airlift units will have been converted to other missions—three to Tactical Air Support, one to C–9 Associate Aeromedical Airlift and four probably to AC–119 Gunship and/or Tactical Air Support. In addition to these 8 units and the 11 C–141 associate units, the Air Force Reserve will have 5 C–119, 14 C–124, 3 C–130 and 1 C– 130 CCTS (Combat Crew Training School) airlift units.

All of the 26 Air National Guard airlift groups in existence at the beginning of FY 1968 will be retained through FY 1969. However, in FY 1968, one group was converted to Aeromedical Airlift and another to Tactical Electronic Warfare (TEW). In FY 1969, three more groups are being converted to Aeromedical Airlift and three to Tactical Air Support. Two more groups will be converted to other (as yet undetermined) missions in FY 1970. The remaining 16 units will consist of 10 C–124, 2 C–97, 2 C–130, 1 C–123 and 1 C–141 associate.

Navy and Marine Corps Airlift

At the end of FY 1969 the Fleet Tactical Support (FTS) category will consist of 82 aircraft, including C–1/C–2 (Carrier On-board Delivery—COD), C–118, C–130 and C–131 aircraft. The COD force now numbers 37 aircraft. The previous plan was to keep it at that level through FY 1973. Recent experience with the COD force in the Pacific, however, has shown that in periods of peak demand this number of aircraft may not be sufficient to meet urgent or unexpected requirements. Accordingly, we now plan to buy some more C–2A aircraft in FY 1970, at a cost of $37 million. We will also retain through FY 1970 the 24 C–118s we had previously planned to phase out in FY 1969–70. This will provide time for the Navy to complete a more detailed study of the size and composition of the future FTS fleet, which will form the basis for a decision on procurement of a replacement type for the C–118s.

The Marine Corps airlift force is the same as that described last year, a total of 71 aircraft. Pending further study of Marine Corps requirements relative to the intra-theater capabilities of the regular airlift forces, we plan to retain all of these aircraft.

The Navy Reserve airlift force is also the same as that presented a year ago, except that 34 C–54s will be retained until the C–118s become available from the active forces.

Sealift

Although the ultimate size of the C–5A force is still an unresolved problem, we are now well on our way towards the attainment of the airlift portion of the strategic lift objective. Unfortunately, this is not the case with respect to sealift.

There are two major aspects to the sealift problem. One concerns the long-term adequacy of the nation's total sealift resources, particularly the U.S. Merchant Marine. The other concerns the immediate availability of suitable shipping in the crucial early weeks of a major wartime contingency. The first aspect of the problem cannot be solved by the Defense Department alone; it is a national problem involving other departments and agencies of the Government, as well as private interests. But the second aspect is uniquely related to defense and must be solved within the context of the Defense program.

The most demanding contingency, short of all-out nuclear war, is a major conflict in Europe and Asia simultaneously. To meet the requirements for such a contingency most effectively and economically, we must have a rapid response sealift force under the immediate control of DOD. Moreover, these ships must have certain special capabilities. First, because we may have to place them on station fully or partially loaded, they must be able to store wheeled and tracked vehicles for prolonged periods and be able to maintain and activate them in place. Second, because these ships will be the first to arrive in a contingency area, they must be able to unload cargo rapidly with no other assistance and even where no ports exist. Third, because of the increasing use of helicopters in the Army forces, these ships must be able to transport large quantities of helicopters (including the flying crane CH–54s) in a ready-to-fly condition; this means that maintenance facilities must be aboard ship.

Our existing Defense Department-controlled inter-theater sealift force is completely inadequate, both quantitatively and qualitatively, and cannot meet this requirement. It consists of 15 Victory ships (T–AKs), 6 aircraft ferries (which are old, converted cargo ships) and 2 roll-on/roll-off ships, one constructed in 1958 and the other in 1966. In addition, we have three FFD Victory ships and one new, privately-owned roll-on/roll-off ship, the Admiral Callaghan, on long-term charter. This present sealift force has only limited usefulness for rapid deployment. Its special capabilities are very limited and it is not immediately available because it is fully engaged during peacetime in point-to-point cargo carriage.

The 30-ship Fast Deployment Logistic (FDL) force which we have proposed for the last two years would have provided us with this needed rapid response sealift force. No other alternative examined over the last several years, except the procurement of additional airlift aircraft which would be prohibitively expensive, would provide this same capability on the same time schedule as the FDLs. Nevertheless, in view of the past reluctance of the Congress to authorize the FDL program and because a rapid response sealift force is so essential, we have continued our search for alternative solutions. One such solution, which we now propose, is to build a force of 15 FDLs and obtain the balance of the "immediate" sealift requirement through the long-term charter of up to 30 new type cargo ships to be privately built according to the design criteria specified by the Military Sea Transportation Service.

At least 15 FDLs would still be required under this plan because the new type charter ships would normally be engaged in the peacetime point-to-point carriage of defense cargoes, and would not be able to close forces to a contingency area until a number of days after the FDLs. Without this minimal FDL force, we would not be able to meet our deployment objectives, since these ships would carry the equipment and initial resupply for the units required to reenforce those forces already moved in by airlift. No other ships would be available early enough to meet this particular requirement, and no other ships would have the special characteristics of the FDL.

As presently envisaged, the new MSTS ship would have about one-half the capacity of the FDL and would lack some of its special features, such as a significant helicopter carrying capability, a float-on/float-off capability, dehumidified storage, equipment fueling, and maintenance and activation facilities. Nor could this ship discharge its cargo as fast as an FDL. However, we estimate that the average cost of the first 10 ships would be about \$20–\$25 million, compared with an average cost of \$52 million for the FDL (based on a 15-ship program).

MSTS has already conducted a design competition for the new cargo ship and is now evaluating the five designs submitted. When a final design is selected, MSTS will ask for bids on the basis of an initial 5-year charter, plus options for three 5-year extensions. The successful bidder (or bidders) would then use the contractual commitment from MSTS to obtain private financing for the construction of the ships. Thus, no government obligation would be involved, except for the MSTS commitment to charter the ships. We now expect to place the first 10 ships on contract in FY 1970, with not more than two firms in order to achieve some of the economies inherent in multi-ship construction.

With regard to the FDLs, we have included \$187 million in the FY 1970 budget to fund the first three ships. The remaining 12 are programmed in FY 1971–73, 4 in each year. (It should be noted that the average cost of an FDL is now estimated at \$52 million compared with \$47 million a year ago. Most of this increase is the result of the reduction in the program from 30 to 15 ships; the balance reflects the general increase in shipbuilding costs.)

In addition to this rapid response sealift force, we will still require a substantial amount of U.S. commercial shipping, up to 460 notional

cargo ships[*] to meet two simultaneous major contingencies in Europe and Asia in the mid-1970s. Today's U.S. commercial cargo fleet, 635 notional ships (including 340 subsidized and 90 non-subsidized liner ships in foreign trade, 55 in domestic trade and 150 tramp freighters), is large enough to fulfill that requirement. However, the overall capability of the fleet is decreasing as older, World War II-built ships are retired. We expect that all of the existing non-subsidized liner ships in foreign trade will have been retired by 1975, and that we cannot count on the continued availability of the present domestic trade and tramp fleets. Accordingly, we must assume that the subsidized liner fleet will be the primary, if not the sole, source of commercial augmentation in the mid-1970s. This is so because only the directly subsidized fleet receives subsidies to permit the construction of new ships in the United States.

The subsidized ships less than 15 years old now in the fleet, plus those presently under construction in U.S. yards, represent the equivalent of 300 notional ships. Of the approximately 422 cargo ships now in the National Defense Reserve Fleet (NDRF) only 167 Victory ships, equivalent to about 132 notional ships, are expected to be available in the mid-1970s. Thus, the total available from these two sources would be about 432 notional ships.

It is clear, therefore, that additional commercial shipping will have to be constructed if we are going to be able to meet our total military contingency requirement in the mid-1970s. (Urgent civilian requirements for U.S. flag shipping would be in addition to these military contingency requirements.) A part of this need could be met by converting the 100 AP-5 troop ships now in the NDRF.

Conversion of the AP-5s would, however, provide only a partial solu- ... roblem of ... t Marine. In May 1968, the Department of Transportation proposed a new maritime program designed to make available sufficient NDRF and subsidized private shipping to fulfill our total emergency needs. The Congress, however, did not act on those proposals, and the longer-range problem still remains unresolved. A solution to this problem is urgently needed, and the Defense Department will do all it can to contribute to the solution.

A "notional" ship is a standard measure for aggregate shipping capability. It is defined as a ship with a 15,000 measurement ton-capacity, a 15-knot speed, and a 5-day loading or unloading capability.

Over and above the problem of total capacity is the need for a plan which would ensure the timely availability of commercial sealift augmentation in future emergencies on the basis of predetermined contractual commitments, schedules and prices. Such a plan, called RESPOND, was developed last year and was to have been implemented partially in FY 1969 and fully in FY 1970. However, an unresolved question about the legality of one part of the program (*i.e.*, the proposal to procure shipping on a uniform cost-based rate schedule for each trade route, rather than by competitive negotiation), as well as opposition by some of the unsubsidized steamship operators, made it desirable to delay implementation until the Comptroller General had an opportunity to review the program. This review was completed in October 1968. The Comptroller General ruled favorably on the legal issues involved, and we now plan to go ahead with the program.

We plan to ask all operators solicited in connection with the FY 1970 commercial sealift buy to provide us with an emergency commitment of a portion of their fleet. In addition, we are presently working out the procedures for allocating peacetime defense cargo on the basis of the operator's (both subsidized and unsubsidized) emergency vessel commitment and the service he guarantees to provide DOD in peacetime. We hope that this effort will be completed in time so that the FY 1970 cargo allocation can be based on these two factors as well as the competitively determined rates. If this is not possible, cargo will be allocated under present procedures, and implementation of the new cargo allocation process will be delayed until FY 1971.

We also plan, at a later stage, to implement a schedule of uniform rates applicable to all carriers on each trade route. These rates will be based on cost and vessel utilization data to be submitted by the carriers, which will be evaluated by MSTS on the basis of criteria furnished by the Federal Maritime Commission (FMC). The FMC will also serve as an arbiter in the event that disputes arise between DOD and industry after the cost-based rates have been implemented. The complexities involved in working out the new rate system virtually preclude its use before FY 1971.

With regard to the balance of the sealift program, four changes are worthy of note.

First, we planned last year to start during the FY 1970–72 period the construction of 9 new tankers to replace the 16 T-2 tankers now in the MSTS fleet. (The new tankers, 25,000 tons dead-weight and 32-foot draft or less, are needed primarily to provide deliveries to ports which cannot handle the larger tankers.) Now, we plan to obtain these tankers through long-term charter, rather than by new procurement. They will be built to MSTS design criteria and operated under MSTS control. As the new tankers become available in the FY 1971–73 period, the T-2s will be phased out, and the MSTS nucleus fleet tanker force will be reduced from the present level of 26 ships to 21 in FY 1971, 14 in FY 1972 and 10 in FY 1973.

Second, we had planned to retain 16 troop ships through FY 1970, phasing down to 8 in FY 1971. Now, we plan to retain 11 through FY 1970 and phase down to 10 in FY 1971. The two additional ships will be needed to lift the ground support personnel associated with the SATS airfield operation for the air wing of a Marine Expeditionary Force, a new requirement which was discussed earlier in connection with the Amphibious Forces.

Third, seven cargo ships which we had planned to phase out in FY 1971 will be retained until FY 1972, pending further analysis of our sealift needs in the light of the proposed new MSTS charter cargo ship program. We have asked the Navy to identify the ships now in the MSTS nucleus fleet which could be retired if the new charter ship program goes forward as planned.

Fourth, the planned increase in Forward Floating Depot ships from 3 to 19 will be delayed another year, from FY 1971 to FY 1972.

Research and Development

The research and development program includes all research and development activities not directly identified with systems approved for deployment. Many of the more important of these projects have already been discussed in preceding sections of this statement. Here, however, we are considering the research and development effort as a whole.

As shown in Figure 1, we are requesting a total of $8,174 million in FY 1970 for Research, Development, Test and Evaluation (RDT&E). These funds would provide for all categories of RDT&E effort, including the continued development of systems already approved for deployment. The FY 1970 request is about $170 million higher than the original FY 1969 request of $8 billion, and about $500 million more than the amount actually appropriated for FY 1969.

The overall research and development effort (which includes support from other than RDT&E appropriations) is organized into the following six categories: Research, Exploratory Development, Advanced Development, Engineering Development, Operational Systems Development, and Management and Support. Except for Operational Systems Development, these categories constitute the research and development program discussed in this section of the statement.

Research

This category includes all the work devoted to increasing our knowledge of basic natural phenomena and the solution of a variety of long-term scientific problems relevant to our future national security. The effectiveness of our weapon systems a decade from now depends on maintaining a balanced research effort across the entire spectrum of science and technology pertinent to the defense effort. DOD is the largest user of research output in the nation and must emphasize those areas most likely to be of military benefit in the future. Without a vigorous research program, we would surely lose the technical superiority we now possess. The research program also provides a link between the department and the academic community, a vital tie which keeps open a unique source of new ideas and technologies.

The Research program is organized primarily in terms of the broad sciences (*e.g.*, engineering, physical, etc.) which are in turn broken down into narrower disciplines or fields such as materials, chemistry, oceanography, etc. Because the program consists largely of thousands of individual projects and tasks, each of which requires only modest funding, we must manage it on a "level of effort" basis. The Research programs for FY 1968 and FY 1969, and that proposed for FY 1970, are shown in Figure 2 (page 34).

The amount proposed for FY 1970, $443 million, is about 6 percent higher than FY 1969. Much of the increase is the result of growth in research costs rather than the addition of new projects or the expansion of on-going ones.

As the table shows, we are requesting funds in FY 1970 to continue Project THEMIS, which was started in FY 1967 to stimulate the development of additional academic centers of defense-relevant research. In the first two years, 92 projects were initiated. A recent comprehensive survey found that all but six were producing useful results, and these six will be cancelled if the research product is not rapidly improved. We plan to start about 25 new projects in FY 1969 and about 25 more in FY 1970, for a total of almost 150. (We had originally planned to start 50 projects in each of four years, FY 1967–70, for a total of 200. The Congress, however, reduced the FY 1969 program to 25 new projects, and we are requesting the same number for FY 1970.)

Exploratory Development

The line of demarcation between research and exploratory development is by no means precise, as has been pointed out in previous years. Exploratory development is generally directed toward the application of research results and the exploitation of technological knowledge to develop materials, components, and devices with useful application to new military weapons and equipment. These efforts vary from applied research

Financial Summary of Research and Development

(TOA, $ Millions)

	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969	FY 1970
Research	382	388	410	378	419	443
Exploratory Development	1,126	1,181	1,049	942	912	1,012
Advanced Development	749	759	808	732	976	1,271
Engineering Development	890	871	860	811	725	1,083
Management and Support	1,573	1,628	1,609	1,565	1,622	1,690
Emergency Fund	—	—	—	—	49	50
Sub-Total, Research and Development	4,719	4,778	4,737	4,427	4,703	5,550
Operational Systems Development	2,292	2,667	3,031	3,364	3,409	3,112
Total Research and Development	7,011	7,445	7,768	7,792	8,112	8,662
Less Support from Other Appropriations	559	538	502	489	465	483
Total Obligational Authority RDT&E Appropriation	6,452	6,907	7,266	7,303	7,647	8,179
Financing Adjustments	+31	−161	−94	−18	−68	−5
New Obligation Authority RDT&E Appropriations	6,483	6,746	7,172	7,285	7,579	8,174

Figure 1.

Research Program

(In Millions of Dollars)

	FY 1968	FY 1969	Proposed FY 1970
Engineering Sciences	80	97	98
Physical Sciences	87	89	96
Environmental Sciences	59	65	69
Biological & Medical Sciences	31	33	33
Behavioral & Social Sciences	8	12	13
Nuclear Weapons Effects Research	44	45	50
In-House Indep. Lab. Research	32	31	33
THEMIS	27	28	33
Joint Service Electronics Program	*	6	7
Support from Other Appropriations	10	13	11
Total Research	378	419	443

* This element was included in other programs prior to FY 1969.

Figure 2.

and studies to the development of protoype and "breadboard" components and devices. The emphasis here is on the exploration and proof of the technical feasibility of various approaches to the solution of specific military problems.

The exploratory development program poses some of the same problems for the decision maker as the research effort, particularly in the variety, number and complexity of the projects in both areas. Consequently, we manage exploratory development as well as research in terms of general operational goals and broad technical areas, changing the focus or level of support of individual tasks as our priorities shift from year to year.

We are requesting a total of about $1,012 million for exploratory development in FY 1970, which is slightly above the FY 1969 request of $980 million. The amount actually available in FY 1969, $912 million, is less than the FY 1968 total of $942 million. The decrease in FY 1969 is a result of the reductions made necessary by the Revenue and Expenditure Control Act of 1968, and in no way indicates a lessening of the importance we attach to this program. Every comprehensive study of weapon system developments has ...ulted ...ons ...e

represents a first step in this direction.

The proposed FY 1970 Exploratory Development program would provide about $190 million to support the Advanced Research Projects Agency (ARPA), with the rest about equally distributed among the Army, the Navy and the Air Force.

ARPA operates as a small research and development management team, responding to urgent needs for centralized management of selected advanced research projects, especially those not definitely identified with a specific Service or weapon system. ARPA controls such exploratory development projects as VELA, which is directed toward developing and demonstrating an advanced surveillance system for detecting, locating and identifying nuclear tests. Another ARPA project is AGILE which involves work on special problems of remote area conflicts and focuses primarily on guerrilla warfare situations.

The Army exploratory development program focuses in part on materials, devices and techniques useful to front line troops in a wide variety of the conflict situations that might occur in the future. It also includes specific projects in support of the current effort in Southeast Asia. Examples of the kinds of developments included are new night viewing equipment, better burn treatment techniques, new small arms and even nuclear effect studies.

In a similar manner the Navy Exploratory Development program supports development of Navy and Marine Corps equipment to be used in the Vietnam conflict. Other programs include such items as submarine hull techniques, hydrofoil craft, and submarine detection devices.

Some of the most important areas in the Air Force Exploratory Development program are rocket propulsion, command and control equipment, and materials. Other significant Air Force work is devoted to studies of space guidance and control, power, communications and other techniques of military importance.

Advanced Development

The advanced development phase encompasses all the efforts to develop component and subsystem hardware for use in experimental tests required to determine the potential military utility of various projects, their specific military applications, and the cost estimates associated with alternative applications. The total amount of funds devoted to advanced development fluctuates within a fairly wide range from year to year as new projects are started and older projects are either dropped, or moved on into engineering development or operational systems development. Before embarking on full-scale development of any new or improved weapon system for which we have identified a requirement, we must provide the necessary foundation by solving in the advanced development phase problems related to the basic components and technology of the new system. A total of $1,271 million is included in the FY 1970 budget for Advanced Development, compared with $976 million in FY 1969.

Sizeable increases ($15 million or more) in 10 advanced development projects account for $221 million of the additional $295 million requested for FY 1970. These 10 projects are briefly discussed:

- **Heavy Lift Helicopter.** This is a new aerial crane configured Army helicopter with a load capability in the range of 20 to 30 tons. The increased funding (from $1 million in FY 1969 to $20 million in FY 1970) will provide for contract definition, which includes some advanced component technology effort.
- **Surface-to-Air Missile Development (SAM-D).** This is an on-going advanced development of a follow-on

to the Hawk and Hercules systems for the defense of theater forces. It is designed to counter both aerodynamic and tactical ballistic missile threats. The increased funding (from $60 million in FY 1969 to $75 million in FY 1970) would permit the initiation of engineering development when a final decision to proceed to that stage is made later this year.

• **Nike-X Advanced Development.** This on-going program is directed to the development of more advanced ABM technology, *i.e.*, beyond that required for the presently approved Sentinel system. Funding has been increased from $137 million in FY 1969 to $175 million in FY 1970, to support new developments in interceptor and discrimination technology and a greater effort on the very important systems studies.

• **Project Mallard.** This project is a cooperative effort of the United States, United Kingdom, Canada and Australia to develop and procure a common tactical communications system for their respective armies and associated air forces and, where appropriate, their navies. The increased funding (from $8 million in FY 1969 to $21 million in FY 1970) will permit the program to enter the modeling and simulation testing phase, where work will be carried out on construction and test of functional models of the most promising subsystem designs.

• **Underseas Long-Range Missile System (ULMS).** This program is a further evolutionary step in the Fleet Ballistic Missile Program, aimed at countering possible improvements in Soviet anti-submarine warfare capability. The objectives of the program are to develop a new design submarine and a new, longer-range missile which will greatly increase submarine operating areas. The funds requested for FY 1970 will be used, primarily, to define the basic characteristics of the submarine.

• **Ocean Engineering System Development.** This program supports various deep submergence ocean vehicle systems: a Deep Submergence Rescue Vehicle, a Large Object Salvage System, a Deep Submergence Search Vehicle, a Small Object Recovery Device and a Location Aid Device. Most of the increase in funding (from $20 million in FY 1969 to $35 million in FY 1970) will be used to support the Deep Submergence Search Vehicle and the Small Object Recovery Device, both of which will be able to operate down to 20,000 feet. The Deep Submergence Rescue Vehicle, which will be able to operate down to 5,000 feet, also requires a modest increase in funding.

• **Advanced Manned Strategic Aircraft (AMSA).** This aircraft is being designed as a possible replacement for the B-52G and H series in the 1978 and later time period. The increase in funding (from $25 million in FY 1969 to $77 million in FY 1970) reflects the decision to proceed with detailed design, wind tunnel testing and mockups, up to the point of readiness to build a full-scale aircraft.

• **Subsonic Cruise Armed Decoy (SCAD).** This air-launched vehicle is designed to ensure the ability of our manned bomber force to survive in a much more advanced Soviet air defense environment in the mid-1970s. The increase in funding over FY 1969 will permit a reasonable rate of development of this new system.

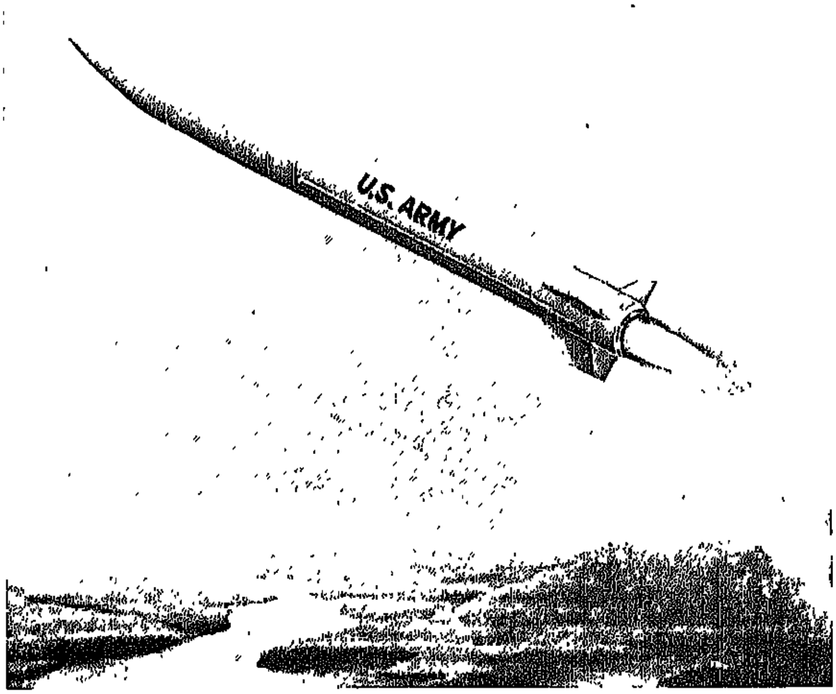
• **Advanced Ballistic Reentry System (ABRES).** This is a continuing long-range program for the advanced development of reentry and penetration technology and devices, with the results appearing gradually over a period of time in new reentry vehicles. The $121 million requested for FY 1970 (*vs.* $105 million in FY 1969) will provide the necessary level of effort in the critical areas of the ABRES program, such as the development of reentry vehicles, new heatshields and hardening concepts, and penetration aids (decoys, chaff, electronic countermeasures, etc.).

• **CONUS Air Defense Interceptor.** This is a program to define an advanced Air Defense Interceptor or to develop modifications to modernize an existing interceptor. A request for authorization of a $28 million program was denied by the Congress last year. For FY 1970, we are requesting $18.5 million to perform comparison studies and complete contract definition of the selected system, or to perform contract definition of the F-106X fire control system and start engineering of airframe and missile modifications.

Engineering Development

Engineering development includes all efforts on systems designed and engineered for operational use, but not yet approved for procurement and deployment. In this phase, large commitments are often made to individual programs and it is important that their specific usefulness be care-

SURFACE-TO-AIR MISSILE (SAM-D) is designed to counter both aerodynamic and tactical ballistic missile threats.



fully measured before they are advanced to engineering development.

A total of $1,083 million has been requested for this category in FY 1970, compared with $725 million in FY 1969 and $811 million in FY 1968. Seven major items which require increased funding in FY 1970 account for $345 million of the $358 million increase over FY 1969. Four of these are important new aircraft: the VSX, AX, F-14B/C and F-15.

The seven programs are briefly discussed:

• VSX. This is the Navy's new fixed wing ASW aircraft, designed to operate from ASW carriers. The funding increase over FY 1969 will permit the attainment of the approved initial operational capability (IOC) date in the early 1970s.

• AX. This is a new specialized close support aircraft development for the Air Force, to be initiated with the $12 million requested for FY 1970. The FY 1970 funds will permit completion of concept formulation and initiation of contract definition.

• F-14B/C. These Navy aircraft are possible replacements for the F-4. Both models would use the same basic airframe as the F-14A and would incorporate the advanced technology engine. In addition, the F-14C would have an advanced avionics suit. The increased funding over FY 1969 would permit initial operating capability in the mid-1970s for the F-14B and the late 1970s for the F-14C.

• F-15. This is the Air Force's air superiority fighter for the mid-1970s. A total of $175 million is requested for FY 1970, compared with the $45 million provided for FY 1969. Contract definition awards were made in December 1968.

• Advanced Surface Missile System (ASMS). This Navy program supports an integrated surface-to-air and surface-to-surface missile system for new or modernized escorts. The funding increase over FY 1969 matches the missile development schedule to that of the first DXG, which is expected to join the fleet in mid-1970s. The ASMS system uses a phased array radar and will be employed on DXGNs as well as DXGs.

• Submarine Sonar Development. This program supports improvement in our SSN sonars to keep ahead of Soviet developments. Because of its importance, a substantial funding increase is required in FY 1970.

• Hard Rock Silo Development. The objective of this program is the development of super-hard launch and launch control facilities. The funding increase (from $25 million in FY 1969 to $50 million in FY 1970) will permit a demonstration test in the early 1970s. (In addition, $8 million has been included in operations and maintenance for site surveys to reduce operational leadtime.)

Nuclear Testing and Test Detection

The Defense Department continues to share with the Atomic Energy Commission the responsibility for the maintenance of the four specific safeguards associated with the Limited Test Ban Treaty. For the Defense Department's portion of this program, we have budgeted a total of $231 million in FY 1970, of which $186 million is for research and development. This compares with $219 million in FY 1969, with $172 million for research and development.

In support of the first safeguard —underground testing—the Defense Department has the responsibility for the provision of nuclear effects data relevant to the vulnerability and survivability of our strategic offensive and defensive systems, as well as those supporting systems which may be required to operate in a nuclear environment. This is accomplished by exposing system components (reentry vehicles, guidance systems, structures, electronics packages, etc.) and materials to the effects of nuclear detonations. We have included $48 million in the FY 1970 budget for this purpose, compared with $40 million in FY 1969. The increase is due in large part to tests associated with the Sentinel system. These tests involve larger system components, and site construction is therefore more expensive.

In support of the second safeguard —maintenance of nuclear laboratory facilities and programs—the FY 1970 budget request includes $67.6 million, compared with $67.4 million in FY 1969. This safeguard is designed to provide answers to vital questions concerning vulnerability and survivability of military systems. A secondary objective is the development of nuclear effects simulators for laboratory and field use, as well as computer techniques for better prediction of effects. Also included in this category is research and exploratory development in new fuzing techniques, arming and control of nuclear weapons, new delivery techniques and weapon componentry.

The third safeguard concerns the maintenance of a capability to resume atmospheric testing on a timely basis, if a change in the situation should so require. This program provides for the maintenance of the scientific and operational facilities at Johnston Atoll and the support of Joint Task Force 8, which is responsible for the conduct of readiness exercises. The program is now being reoriented to include tests pertinent to ABM systems and effects on missiles and reentry vehicles in a dynamic situation. The FY 1970 budget includes $21.9 million for the support of the readiness program, compared with $18 million in FY 1969.

The fourth safeguard involves the monitoring of the terms of the Limited Test Ban Treaty. Nuclear test detection also provides a means for evaluation of foreign nuclear weapons programs. Two distinct efforts are involved—the ARPA VELA program and the Atomic Energy Detection System (AEDS). Our FY 1970 budget includes $93.9 million for the support of this safeguard, compared with $92.7 million now planned for FY 1969.

Space Development Projects

Inasmuch as the various elements of the Defense Department space effort are included in several program and budget categories, we have followed the practice of recapitulating the entire program at this point in the statement.

The Defense Department's program is wholly integrated into the National Space Program. It is designed to apply space technologies to our strategic and tactical weapon systems in order to increase their effectiveness, exploit the new potential in information systems made possible by satellite-based communications and sensors, and explore the usefulness of manned space systems for defense purposes. Despite these broad objectives, we have continued to exercise great care to avoid any duplication

of work already being done by the National Aeronautics and Space Administration (NASA) or other agencies engaged in the National Space Program.

We are requesting a total of $2,219 million for the Defense Space Program in the coming fiscal year, about the same amount originally requested for FY 1969 but about $135 million more than the amount actually provided for that year.

The largest share of the FY 1969 reduction in space projects (*i.e.*, $85 million) was applied to the Manned Orbiting Laboratory (MOL) program, reducing it from $600 million to $515 million. The MOL, however, is still by far the largest project in the Defense Department Space Program and almost $580 million is included in the FY 1970 budget for this effort. We are presently scheduling the first qualification flight in early CY 1971 and the first manned flight a year later.

A major factor in the effective use of our forces overseas is the adequacy of communications both within the area of operations and between that area and higher echelons including the seat of Government. Currently, we depend on a combination of leased and government-owned wire, conventional radio, and satellite communications systems. Experience with our present Defense Satellite Communications System (DSCS) and analysis of technically feasible advances clearly demonstrate the potential improvements in both strategic and general purpose communications offered by this new technique. Therefore, we have decided to proceed with major improvements to the DSCS.

The improved system, known as DSCS Phase II, will consist of new, high-powered synchronous satellites, existing terminals modified to operate effectively with the new satellites, and new terminals having greater capacity and reliability and, in some cases, greater transportability. The satellites will be equipped with a single earth-coverage antenna and two steerable, narrow-beam antennas. The earth-coverage antenna distributes its radiated energy in a relatively uniform manner over that portion of the earth visible to the satellite while each narrow-beam antenna concentrates its energy in an area a few thousand miles in diameter. This concentration of energy permits effective use of smaller, more easily transported terminals to support contingency operations. The system could, for example, provide about 50 voice channels into a contingency area, several hundred channels within the area, and several wideband channels which might be used to transmit high quality photographic material or high quality secure speech. This capacity and the rapidity with which it can be installed represent a tremendous advance over our existing capability.

We expect to launch the first satellite in early 1971 at which time all existing terminals will be modified and we will introduce new terminals about a year later. We will initiate development in FY 1969 and start procurement in FY 1970 of the items required for the implementation of the improved Satellite Communications System in FY 1971. This new system accounts for the sharp increase in the DOD Satellite Communications program in FY 1970, $149 million *vs.* $71 million in FY 1969.

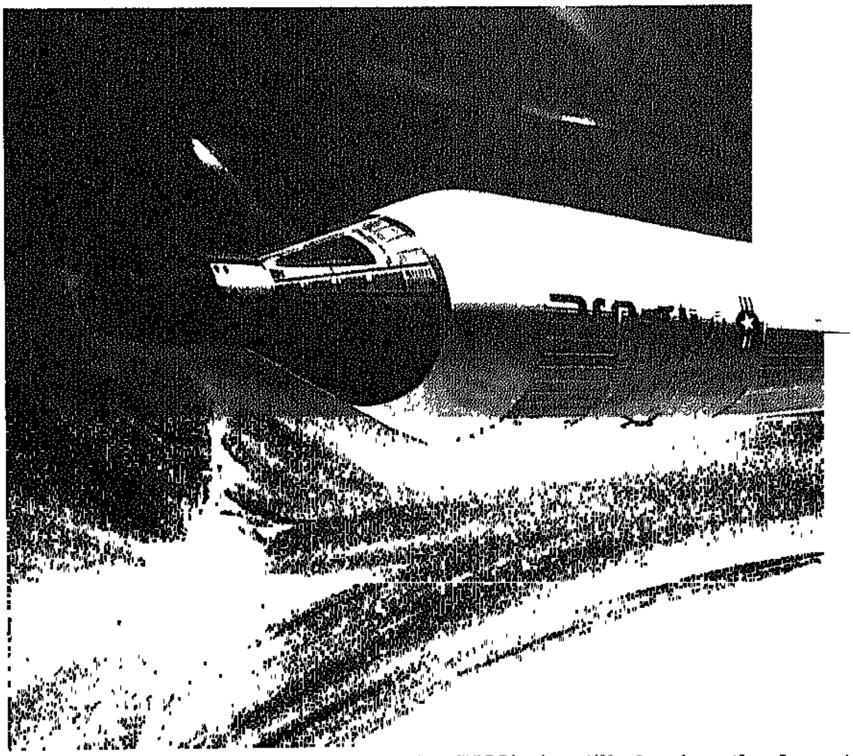
These two projects, Satellite Communications and the Manned Orbiting Laboratory, account for more than the total increase in the Defense Space Program in FY 1970.

Management and Support

A total of about $1,690 million has been included in the FY 1970 budget for the support of research and development installations and activities required for general research and development use. The increase of about $68 million over FY 1969 primarily reflects higher price levels.

Emergency Fund

Last year we requested $125 million for the Emergency Fund, but the Congress provided only $50 million. This year, in spite of the urgent need for the flexibility provided by this fund, we have limited our request to $50 million (plus the usual $150 million of transfer authority), which is far below the amounts provided by the Congress in the years before FY 1969. And, even in those years we found the Emergency Fund inadequate to meet all of the varying requirements of the Southeast Asia conflict and other essential, but unpredictable, research and development demands. Accordingly, the $50 million requested for FY 1970 must be considered an absolute minimum.



MANNED ORBITING LABORATORY (MOL) is still, by far, the largest project in the Defense Department space program. The first qualification flight is scheduled for CY 1971, the first manned flight a year later.

Financial Tables Relating to Defense Department Budget for FY 1970

Table No. 1

Department of Defense
BUDGET SUMMARY—FY 1970

(Millions of Dollars)

	FY 1968	FY 1969	FY 1970
Total Obligational Authority (TOA):			
Military Personnel	22,055	23,996	24,384
Operation and Maintenance	20,950	22,516	21,941
Subtotal—Operations	43,005	46,512	46,325
Procurement	23,610	24,455	25,124
Research, Development, Test & Evaluation	7,303	7,647	8,179
Military Construction	1,613	1,382	1,951
Family Housing	600	536	634
Civil Defense	86	61	75
Special Foreign Currency Program	—	11	4
Subtotal—Military Functions	76,216	80,554	82,293
Military Assistance	600	748	709
Total—TOA	76,816	81,302	83,002
Financing Adjustments	−69	−4,003	−1,970
Budget Concepts Adjustments*	−345	−301	−387
Budget Authority (New Obligational Authority—NOA)	76,402	76,998	80,645
Outlays (Expenditures)	78,027	78,400	79,000

Notes:

FY 1969 TOA and NOA amounts include proposed supplemental appropriations as follows: Southeast Asia special support, $1,631,500,000; military pay increase, $907,200,000; civilian pay increase, $198,900,000; wage board increases, $84,600,000; retired pay cost of living increase, $162,000,000; other supplementals under existing legislation relating to reservists and National Guard technicians, $27,700,000.

udget concepts adopted in the fall of 1967, and appearing
D, these concepts adjustments include certain receipts from
Receipts from the public include those which, under the
e DOD but are deposited in a Treasury receipt account.
roperty, equipment rentals, and recoveries under con-
, but they can be used only for the purposes of the trust.
nvolve amounts paid in by individuals to be used for
nanced through a military assistance trust fund, and
and collections of that fund.

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Table No. 2 Department of Defense

FINANCIAL SUMMARY BY PROGRAM, DOD COMPONENT AND FUNCT.ONAL CLASSIFICATION

(Millions of Dollars)

	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969	FY 1970
Program						
Strategic Forces	6,855	6,502	6,532	7,615	9,116	9,596
General Purposes Forces	18,899	28,801	31,916	32,411	33,246	32,126
Intelligence and Communications	4,480	4,998	5,350	5,683	6,007	6,185
Airlift and Sealift	1,342	1,610	1,857	1,860	1,629	2,072
Guard and Reserve Forces	1,943	2,318	2,673	3,185	2,673	2,913
Research and Development	4,719	4,778	4,737	4,427	4,703	5,550
General Supply and Maintenance	4,728	5,940	7,721	8,217	8,811	8,971
Training, Medical, etc.	5,870	7,439	8,973	9,969	10,245	10,686
Administration and Associated Activities	1,191	1,487	1,335	1,347	1,491	1,465
Support of Other Nations	1,149	2,040	2,358	2,376	3,459	3,231
Retired Pay—Appropriation over/under(—) accrual	−517	−465	−409	−272	−79	206
Total Obligational Authority (TOA)	50,657	65,449	73,042	76,816	81,302	83,002
Financing adjustments	−164	−1,916	−318	−69	−4,003	−1,970
Budget concepts adjustments	NA	NA	268	−345	−301	−387
Budget Authority (NOA)	50,493	63,533	72,992	76,402	76,998	80,645
Budget Outlays	47,401	55,377	68,331	78,027	78,400	79,000
Outlays as Percentage of GNP	7.3	7 8	9.0	10.5	8.8	8.3
DOD Component						
Department of Army (Incl. OCD & Foreign Currency)	12,361	18,633	22,600	25,447	26,684	26,407
Department of Navy (Incl. Foreign Currency)	14,731	19,190	21,339	21,242	22,458	24,409
Department of Air Force (Incl. Foreign Currency)	19,505	23,054	24,602	25,287	26,670	26,232
Defense Agencies (Excl. Fam. Housing & Foreign Cur.)	2,485	2,917	3,320	3,641	4,206	4,620
Family Housing	576	609	439	600	536	634
Military Assistance	1,000	1,046	743	600	748	709
Total Obligational Authority (TOA)	50,657	65,449	73,042	76,816	81,302	83,002
Functional Classification						
Military Personnel	14,816	17,047	20,067	22,055	23,996	24,384
Operation and Maintenance	12,572	15,018	19,434	20,950	22,516	21,941
Procurement	14,081	22,154	23,743	23,610	24,455	25,124
Research, Development, Test, and Evaluation	6,452	6,097	7,266	7,303	7,647	8,179
Military Construction	1,060	2,562	1,245	1,613	1,332	1,951
Family Housing	576	609	439	600	536	634
Civil Defense and Spec. Foreign Currency Program	102	105	105	86	72	79
Military Assistance	1,000	1,046	743	600	748	709
Total Obligational Authority (TOA)	50,657	65,449	73,042	76,816	81,302	83,002

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Table No. 3

Department of Defense

DIRECT BUDGET PLAN (TOA), BUDGET AUTHORITY (NOA), AND OUTLAYS

Fiscal Years 1968–1970

(Millions of Dollars)

	Direct Budget Plan (TOA)			Budget authority (NOA)			Outlays		
	FY 1968	FY 1969	FY 1970	FY 1968	FY 1969	FY 1970	FY 1968	FY 1969	FY 1970
Functional Classification									
Military Personnel									
Active Forces	19,086	20,593	20,600	19,100	20,593	20,600	18,988	20,817	20,456
Reserve Forces	875	953	1,049	923	953	1,049	871	907	988
Retired Pay	2,093	2,450	2,735	2,095	2,450	2,735	2,095	2,441	2,720
Total—Military Personnel	22,055	23,996	24,384	22,118	23,996	24,384	21,954	23,665	24,164
Operation and Maintenance	20,950	22,516	21,941	20,950	22,516	21,941	20,578	22,106	21,841
Subtotal—Operations	43,005	46,512	46,325	43,068	46,512	46,325	42,532	45,771	46,005
Procurement	23,610	24,455	25,124	23,408	20,784	23,241	23,283	24,337	23,435
Research, Dev., Test, and Eval.	7,303	7,647	8,179	7,285	7,579	8,174	7,747	7,545	7,805
Emergency Fund, Southeast Asia	—	—	—	56	—	—	—	—	—
Military Construction	1,613	1,332	1,951	1,543	1,168	1,949	1,281	1,508	1,370
Family Housing	600	536	634	612	523	618	495	630	625
Civil Defense	86	61	75	86	60	75	108	82	72
Special Foreign Currency Program	—	11	4	11	—	—	2	2	4
Working Capital Accounts	—	—	—	178	—	—	2,090	−1,947	−694
Military Assistance	600	748	709	500	671	650	601	548	591
Budget concepts adjustments:									
Trust funds	—	—	—	781	817	757	1,015	1,042	931
Intragovernmental transactions	—	—	—	−7	−7	−7	−7	−7	−7
Offsetting receipts	—	—	—	−1,119	−1,111	−1,137	−1,119	−1,111	−1,137
Total—Budget concepts adj.	—	—	—	−345	−301	−387	−111	−77	−213
Total—Department of Defense	76,816	81,302	83,002	76,402	76,998	80,645	78,027	78,400	79,000
Department or Agency									
Department of the Army	25,361	26,618	26,331	25,237	25,262	25,862	25,223	24,920	25,094
Department of the Navy	21,242	22,453	24,408	21,122	20,995	23,736	22,071	22,573	22,766
Department of the Air Force	25,287	26,669	26,222	25,196	25,435	25,353	25,784	25,933	25,549
Defense Agencies/OSD	4,241	4,753	5,256	4,450	4,742	5,211	4,237	4,282	4,997
Civil Defense	86	61	75	86	60	75	108	82	82
Total—Military Functions	76,216	80,554	82,293	76,091	76,495	80,238	77,873	77,790	78,471
Military Assistance	600	748	709	312	503	408	654	610	529
Total—Department of Defense	76,816	81,302	83,002	76,402	76,998	80,645	78,027	78,400	79,000

Note:
(1) FY 1969 TOA and NOA amounts include proposed supplemental appropriations as follows: Southeast Asia special support, $1,631,500,000; military pay increase, $907,200,000; civilian pay increase, $198,900,000; wage board increases, $84,600,000; retired pay cost of living increase, $162,000,000; other supplementals under existing legislation relating to reservists and National Guard technicians, $27,700,000.

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Table No. 4

Department of Defense
DIRECT BUDGET PLAN (TOA), BUDGET AUTHORITY, AND OUTLAYS
Fiscal Years 1968–1970 by Functional Classification and Department or Agency
(Millions of Dollars)

	Dept. of Defense—Total			Dept. of the Army			Dept. of the Navy			Dept. of the Air Force			Def. Ags/OSD/ OCD/MAP		
	FY 1968	FY 1969	FY 1970	FY 1968	FY 1969	FY 1970	FY 1968	FY 1969	FY 1970	FY 1968	FY 1969	FY 1970	FY 1968	FY 1969	FY 1970
Total Obligational Authority (TOA):	76,816	81,302	83,002	25,361	26,618	26,331	21,242	22,453	24,408	25,287	26,669	26,222	4,928	5,563	6,041
Military Personnel															
Active Forces	19,086	20,593	20,600	7,820	8,491	8,535	5,588	6,004	6,106	5,677	6,098	5,959	—	—	—
Reserve Forces	875	953	1,049	570	614	675	157	175	185	148	165	189	—	—	—
Retired Pay	2,093	2,450	2,735	—	—	—	—	—	—	—	—	—	2,093	2,450	2,735
Total—Military Personnel	22,055	23,996	24,384	8,391	9,105	9,210	5,745	6,179	6,291	5,825	6,263	6,148	2,093	2,450	2,735
Operation and Maintenance	20,950	22,516	21,941	8,372	8,342	7,902	5,402	5,848	5,840	6,169	7,207	7,049	1,007	1,120	1,150
Subtotal—Operations	43,005	46,512	46,325	16,763	17,447	17,112	11,147	12,027	12,131	11,994	13,470	13,197	3,100	3,570	3,885
Procurement															
Aircraft	9,469	8,409	8,157	1,282	843	941	2,760	2,478	2,659	5,428	5,088	4,556	—	—	—
Missiles	2,518	3,390	4,115	493	926	1,348	601	781	885	1,424	1,682	1,882	—	—	—
Ships	1,232	1,207	2,849	—	—	—	1,232	1,207	2,848	—	—	—	—	—	—
Tracked Combat Vehicles	424	296	336	406	284	298	18	12	38	—	—	—	—	—	—
Ordnance, Vehicles & Rel. Equip.	6,443	7,403	6,116	3,023	3,548	2,651	1,769	1,841	1,776	1,650	2,013	1,689	1	1	1
Electronics & Communications	1,428	1,592	1,374	609	669	432	465	537	462	346	379	466	8	7	15
Other Procurement	2,096	2,158	2,177	744	617	663	809	1,072	994	500	419	427	44	50	92
Total—Procurement	23,610	24,455	25,124	6,556	6,887	6,333	7,653	7,928	9,662	9,348	9,581	9,020	53	58	108
Research, Dev., Test, & Eval.															
Military Sciences	536	586	631	162	172	182	147	153	160	143	152	159	84	109	130
Aircraft	1,126	987	1,354	138	117	132	217	396	577	762	473	645	8	1	—
Missiles	2,485	2,467	2,483	658	755	883	769	713	552	953	938	976	105	60	72
Military Astronautics	1,038	1,168	1,151	7	11	14	15	18	24	1,013	1,136	1,110	3	3	3
Ships and Small Craft	248	344	346	*	*	*	248	344	345	—	—	—	—	—	—
Ordnance, Vehicles & Rel. Equip.	323	334	302	174	171	193	150	164	109	—	—	—	—	—	—
Other Equipment	1,127	1,221	1,334	348	351	363	244	237	285	277	384	400	258	250	286
Program-wide Management & Support	420	491	528	35	53	54	96	137	154	278	291	309	11	11	10
Emergency Fund	—	49	50	—	—	—	—	—	—	—	—	—	—	49	50
Total—RDT&E	7,303	7,647	8,179	1,522	1,629	1,822	1,886	2,161	2,207	3,426	3,373	3,599	469	484	551
Military Construction	1,613	1,332	1,951	521	655	1,064	554	338	408	518	245	404	20	95	75
Family Housing	600	536	634	—	—	—	—	—	—	—	—	—	600	536	634
Civil Defense	86	61	75	—	—	—	—	—	—	—	—	—	86	61	75
Special Foreign Currency Program	—	11	4	—	—	—	—	—	—	—	—	—	—	11	4
Total—Military Functions	76,216	80,554	82,293	25,361	26,618	26,331	21,242	22,453	24,408	25,287	26,669	26,222	4,328	4,815	5,332
Military Assistance	600	748	709	—	—	—	—	—	—	—	—	—	600	748	709
TOA Total—Dept. of Defense	76,816	81,302	83,002	25,361	26,618	26,331	21,242	22,453	24,408	25,287	26,669	26,222	4,92[illegible]	[illegible]63	6,041
Financing adjustments	−69	−4,003	−1,970	−58	−1,297	−402	−85	−1,419	−633	−35	−1,199	−832	109	−88	−103
Budget concepts adjustments	−345	−301	−387	−67	−58	−67	−35	−39	−39	−55	−35	−37	−188	−168	−242
Budget Authority (NOA)	76,402	76,998	80,645	25,237	25,262	25,862	21,122	20,995	23,736	25,196	25,435	25,353	4,848	5,305	5,694
Outlays	78,027	78,400	79,000	25,223	24,920	25,094	22,071	22,573	22,766	25,734	25,933	25,543	4,999	4,974	5,598

Note:
(1) FY 1969 TOA and NOA amounts include proposed supplemental appropriations as follows: Southeast Asia special support, $1,631,500,000; military pay increases, $907,200,000; civilian pay increase, $198,900,000; wage board increases, $84,600,000; retired pay cost of living increase, $162,000,000; other supplementals under existing legislation relating to reservists and National Guard technicians, $27,700,000.

* Less than $500,000.

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 Table No. 5

Department of Defense

PLANNED OBLIGATIONS AND UNOBLIGATED BALANCES

Fiscal Years 1968–1970

(Millions of Dollars)

	Unobligated balance brought forward	Budget authority (NOA)	Balances transferred	Reimbursable orders	Total available for obligation	Direct obligations	Reimbursable obligations	Write-offs	Unobligated balance carried forward	Unobligated carryover as % of available
Fiscal Year 1968—Actual										
Military Functions										
Military Personnel	—	22,118	—	193	22,311	22,055	193	−64	—	—
Operation and Maintenance	61	20,950	11	2,013	23,035	20,950	2,040	−11	34	0 1
Procurement	11,175	23,408	87	2,911	37,581	24,033	2,848	—	10,701	28 5
Research, Dev., Test, & Eval.	1,003	7,285	—	571	8,859	7,460	541	—	859	9 7
Emergency Fund, Southeast Asia	—	56	—	—	56	—	—	—	56	100 0
Military Construction	1,281	1,543	15	538	3,377	1,296	489	—	1,593	47 2
Family Housing	178	612	—	6	796	566	—	−3	228	28 6
Civil Defense	22	86	—	*	109	100	*	*	8	7 5
Special Foreign Currency Program	5	11	—	—	16	1	—	—	16	96 3
Total–Military Functions	13,725	76,069	113	6,234	96,141	76,459	6,111	−77	13,494	14 0
Military Assistance	12	500	−113	6	406	401	—	—	5	1 2
Total—Department of Defense	13,737	76,569	—	6,240	96,547	76,860	6,111	−77	13,499	14 0
Fiscal Year 1969—Estimated										
Military Functions										
Military Personnel	—	23,996	—	198	24,194	23,996	198	—	—	—
Operation and Maintenance	34	22,516	1	1,905	24,456	22,516	1,921	—	19	0 1
Procurement	10,701	20,784	1,576	3,140	36,201	24,465	3,053	—	8,683	24 0
Research, Dev., Test, & Eval.	859	7,579	—	608	9,046	7,651	615	—	781	8 6
Emergency Fund, Southeast Asia	56	—	−56	—	—	—	—	—	—	—
Military Construction	1,593	1,168	10	758	3,528	1,692	782	—	1,054	29 9
Family Housing	228	523	—	23	774	685	—	−13	75	9 7
Civil Defense	8	60	1	*	69	68	*	—	1	1 4
Special Foreign Currency Program	16	—	—	—	16	6	—	—	9	59 3
Total—Military Functions	13,494	76,628	1,531	6,632	98,284	81,080	6,569	−13	10,622	10 8
Military Assistance	5	671	—	6	682	677	—	—	5	0 7
Total—Department of Defense	13,499	77,299	1,531	6,638	98,966	81,757	6,569	−13	10,627	10 7
Fiscal Year 1970—Estimated										
Military Functions										
Military Personnel	—	24,384	—	198	24,582	24,384	198	—	—	—
Operation and Maintenance	19	21,941	—	1,922	23,882	21,941	1,921	—	20	0 1
Procurement	8,683	23,241	400	3,252	35,576	24,323	3,092	—	8,161	22 9
Research, Dev., Test, & Eval.	781	8,174	—	613	9,568	8,162	614	—	792	8 3
Military Construction	1,054	1,949	—	602	3,605	1,994	647	—	964	26 7
Family Housing	75	618	—	7	700	660	—	−6	34	4 9
Civil Defense	1	75	—	*	76	76	*	—	*	0 5
Special Foreign Currency Program	9	—	—	—	9	9	—	—	—	—
Total—Military Functions	10,622	80,382	400	6,594	97,998	81,549	6,473	−6	9,971	10 2
Military Assistance	5	650	—	6	661	656	—	—	5	0.8
Total—Department of Defense	10,627	81,032	400	6,600	98,659	82,205	6,473	−6	9,976	10 1

Note: Revolving fund transactions and budget concepts adjustments are excluded since they have no impact on direct obligation for service account.
* Less than $500.000.

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Table No. 6

Department of Defense
ESTIMATED OUTLAYS AND UNEXPENDED BALANCES
Fiscal Years 1968–1970
(Millions of Dollars)

	Unexpended balance brought forward	Budget authority (NOA)	Unobl. balances transferred	Total avail. for expend.	Outlays	Restorations and writeoffs	Unexpended balance carried forward	Unexpended carryover as % of avail.
FY 1968—Actual								
Military Functions								
Military Personnel	935	22,118	−27	23,026	21,954	−206	867	3.8
Operation and Maintenance	2,737	20,950	16	23,703	20,578	38	3,163	13.3
Procurement	31,499	23,408	87	54,993	23,283	—	31,711	57.7
Research, Dev., Test, & Eval.	4,759	7,285	—	12,044	7,747	—	4,297	35.7
Emergency Fund, Southeast Asia	—	56	—	56	—	—	56	100.0
Military Construction	2,199	1,543	163	3,905	1,281	—	2,623	67.2
Family Housing	288	612	—	900	495	−4	401	44.6
Civil Defense	114	86	—	200	108	−4	89	44.3
Special Foreign Currency Prog.	7	11	—	19	2	—	17	90.7
Revolving funds	2,689	178	—	2,867	2,090	14	792	27.6
Budget concepts adjustments	26	−157	—	−131	−164	—	33	XX
Total—Military Functions	45,253	76,091	239	121,583	77,373	−161	44,049	36.2
Miltary Assistance								
Military Assistance gen. funds	1,359	500	−261	1,598	619	—	980	61.3
Revolving funds	380	—	−2	378	−18	—	396	104.7
Budget concepts adjustments	3,138	−188	—	2,949	53	—	2,896	98.2
Total—Military Assistance	4,878	312	−263	4,926	654	—	4,272	86.7
Total—Dept. of Defense	50,130	76,402	−24	126,508	78,027	−161	48,320	38.2
FY 1969—Estimated								
Military Functions								
Military Personnel	867	23,996	—	24,863	23,665	—	1,198	4.8
Operation and Maintenance	3,163	22,516	8	25,687	22,106	—	3,581	13.9
Procurement	31,711	20,784	1,576	54,071	24,337	—	29,734	55.0
Research, Dev., Test, & Eval.	4,297	7,579	—	11,876	7,545	—	4,331	36.5
Emergency Fund, Southeast Asia	56	—	−56	—	—	—	—	—
Military Construction	2,623	1,168	10	3,801	1,508	—	2,293	60.3
Family Housing	401	523	—	925	630	−13	281	30.4
Civil Defense	89	60	1	150	82	—	68	45.2
Special Foreign Currency Prog.	17	—	—	17	2	—	15	88.1
Revolving funds	792	—	−1,531	−739	−1,947	—	1,208	XX
Budget concepts adjustments	33	−133	—	−100	−138	—	39	XX
Total—Military Functions	44,049	76,495	7	120,551	77,790	−14	42,747	35.5
Military Assistance								
Military Assistance gen. funds	980	671	—	1,651	551	—	1,100	66.6
Revolving funds	396	—	—	396	−2	−35	363	91.8
Budget concepts adjustments	2,896	−168	—	2,728	62	—	2,666	97.7
Total—Military Assistance	4,272	503	—	4,774	610	−35	4,130	86.5
Total—Dept. of Defense	48,320	76,998	7	125,325	78,400	−48	46,877	37.4
FY 1970—Estimated								
Military Functions								
Military Personnel	1,198	24,384	—	25,582	24,164	—	1,418	5.5
Operation and Maintenance	3,581	21,941	—	25,522	21,841	—	3,681	14.4
Procurement	29,734	23,241	400	53,375	23,435	—	29,940	56.1
Research, Dev., Test, & Eval.	4,331	8,174	—	12,505	7,805	—	4,700	37.6
Military Construction	2,293	1,949	—	4,242	1,370	—	2,872	67.7
Family Housing	281	618	—	899	625	−6	267	29.8
Civil Defense	68	75	—	143	72	—	71	50.0
Special Foreign Currency Prog.	15	—	—	15	4	—	11	76.4
Revolving funds	1,208	—	−400	808	−694	—	1,501	185.9
Budget concepts adjustments	39	−144	—	−106	−150	—	44	XX
Total—Military Functions	42,747	80,238	—	122,985	78,471	−6	44,507	36.2
Military Assistance								
Military Assistance gen. funds	1,100	650	—	1,750	571	—	1,179	67.4
Revolving funds	363	—	—	363	20	−49	295	81.1
Budget concepts adjustments	2,666	−242	—	2,424	−62	—	2,486	102.6
Total—Military Assistance	4,130	408	—	4,537	529	−49	3,959	87.3
Total—Dept. of Defense	46,877	80,645	—	127,522	79,000	−55	48,467	38.0

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Table No. 7

Department of Defense

FY 1969 BUDGET AUTHORITY ENACTED AND PROPOSED SUPPLEMENTALS

(Thousands of Dollars)

			Proposed supplementals			
	An enacted	Transfers and adjustments	Military and civilian pay increase	Southeast Asia activities	Enacted legislation-retired pay & reservists	Revised total
Military Functions						
Military Personnel						
Military Personnel, Army	8,000,000	—	331,000	160,000	—	8,491,000
Military Personnel, Navy	4,235,000	—	198,700	25,300	—	4,459,000
Military Personnel, Marine Corps	1,474,000	—	64,500	6,500	—	1,545,000
Military Personnel, Air Force	5,680,000	—	267,600	150,400	—	6,098,000
Reserve Personnel, Army	287,200	—	5,600	—	—	292,800
Reserve Personnel, Navy	125,000	—	3,500	—	5,000	133,500
Reserve Personnel, Marine Corps	31,100	—	1,600	—	8,300	41,000
Reserve Personnel, Air Force	71,800	—	1,900	—	—	73,700
National Guard Personnel, Army	304,500	—	16,400	—	—	320,900
Nat'l Guard Personnel, Air Force	88,000	—	3,400	—	—	91,400
Retired Pay, Defense	2,275,000	—	13,000	—	162,000	2,450,000
Total—Military Personnel	22,571,600	—	907,200	342,200	175,300	23,996,300
Operation and Maintenance						
Operation and Maintenanc", Army	7,805,000	−259	106,800	152,400	—	8,063,941
Operation and Maintenance, Navy	5,356,200	237	26,100	—	—	5,382,537
Operation and Maintenance, Marine Corps.	435,700	—	4,600	24,300	—	464,600
Operation and Maintenance, Air Force	6,551,000	−395	91,200	282,200	—	6,924,005
Operation and Maintenance, Def. Agencies.	1,036,800	−5,861	40,500	—	—	1,071,439
Operation and Maint., Army Nat'l. Guard.	264,664	—	7,600	—	5,400	277,664
Operation and Maint., Air Nat'l. Guard	267,000	—	6,682	—	9,000	282,682
Claims, Defense	38,000	—	—	—	—	38,000
Contingencies, Defense	10,000	—	—	—	—	10,000
Court of Military Appeals, Defense	636	—	18	—	—	654
Total—Operation and Maintenance	21,765,000	−6,278	283,500	458,900	14,400	22,515,522
Procurement						
Procurement of Equipment & Missiles, Army	5,031,400	—	—	727,800	—	5,759,200
Aircraft Procurement, Air Force	3,860,000	—	—	102,600	—	3,962,600
Other Procurement	11,090,500	−28,000	—	—	—	11,062,500
Total—Procurement	19,981,900	−28,000	—	830,400	—	20,784,300
Research, Development, Test & Evaluation	7,551,328	28,000	—	—	—	7,579,328
Military Construction	1,168,476	—	—	—	—	1,168,476
Family Housing	589,900	−66,408	—	—	—	523,492
Civil Defense	60,540	−125	—	—	—	60,415
Budget Concepts Adjustments	−140,943	8,025	—	—	—	−132,918
Total—Military Functions	73,547,801	−64,786	1,190,700	1,631,500	189,700	76,494,915
Military Assistance						
Military Assistance excluding adj.	671,000	—	—	—	—	671,000
Bidget Concepts Adjustments	−80,000	−88,325	—	—	—	−168,325
	0	−88,325	—	—	—	502,675
		−153,111	1,190,700	1,631,500	189,700	76,997,590

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Table No. 8

Department of Defense
ORDER OF MAGNITUDE DATA ON COMPARATIVE NEW OBLIGATIONAL AUTHORITY BY FUNCTIONAL TITLE
Selected Fiscal Years 1959–1970
(Millions of Dollars)

	FY 1959	FY 1961	FY 1963	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969	FY 1970
Functional classification									
Military Personnel									
Active Forces	10,709	10,695	11,431	12,699	14,655	17,426	19,100	20,593	20,600
Reserve Forces	644	660	672	751	818	951	923	953	1,049
Retired Pay	640	790	1,026	1,399	1,600	1,839	2,095	2,450	2,735
Total	11,993	12,144	13,129	14,849	17,073	20,216	22,118	23,996	24,384
Operation and Maintenance	10,187	10,702	11,496	12,603	15,339	19,434	20,950	22,516	21,941
Subtotal—Operations	22,180	22,846	24,625	27,452	32,412	39,650	43,068	46,512	46,325
Procurement									
Aircraft	6,167	4,998	5,882	5,962	9,354	9,579	9,452	7,519	7,916
Missiles	3,966	2,078	3,969	2,615	1,642	2,207	2,493	3,326	4,027
Ships	1,943	2,246	2,939	1,905	1,522	1,757	1,301	821	2,698
Tracked Combat Vehicles	(a)	(a)	(a)	211	435	517	424	262	336
Ordnance, Vehicles and Related Equipment	545	1,034	1,959	1,431	4,252	5,302	6,311	6,900	5,482
Electronics and Communications	982	935	1,176	1,039	1,240	1,385	1,432	1,478	1,244
Other Procurement	701	425	742	672	1,568	2,125	1,994	2,008	1,937
Total	14,304	11,716	16,667	13,836	20,013	22,871	23,408	22,314	23,641
Research, Development, Test and Evaluation	3,777	6,033	6,993	6,483	6,746	7,172	7,285	7,579	8,174
Military Construction	1,385	1,061	1,204	1,049	2,566	1,098	1,543	1,168	1,949
Family Housing	—	—	590	631	666	507	612	523	618
Civil Defense	—	—	126	105	107	102	86	60	75
Special Foreign Currency Program & Emergency Fund, SEA	—	—	—	—	—	7	67	—	—
Working Capital Accounts (Revolving funds)	57	30	—	—	—	535	178	—	—
Transfers from prior year balances [b]	−535	−366	−410	−193	—	−1	—	−1,530	−400
Military Assistance	1,515	1,785	1,325	1,130	1,023	782	500	671	650
Budget concepts adjustments	(c)	(c)	(c)	(c)	(c)	268	−345	−301	−387
Total—Department of Defense	42,683	43,106	51,119	50,493	63,533	72,992	76,402	76,998	80,645
Department of Agency									
Department of the Army	9,381	9,914	11,631	12,003	17,492	22,876	25,237	25,262	25,862
Department of the Navy	11,820	12,431	15,286	14,845	18,486	20,669	21,122	20,995	23,736
Department of the Air Force	18,713	17,884	20,179	19,219	22,655	24,193	25,196	25,435	25,353
Defense Agencies/OSD	1,255	1,092	2,572	3,192	3,770	3,970	4,450	4,742	5,211
Civil Defense	—	—	126	105	107	101	86	60	75
Military Assistance [d]	1,515	1,785	1,325	1,130	1,023	1,183	312	503	408
Total—Department of Defense	42,683	43,106	51,119	50,493	63,533	72,992	76,402	76,998	80,645

[a] Amount included in entry for "Ordnance, Vehicles, and Related Equipment."
[b] Amounts by functional classification above include transfers from prior year balances to reflect total obligational availability, with this one line deduction to net to NOA.
[c] Data for "Budget concept adjustments" (netted against NOA in the FY 1969 and FY 1970 Budget presentations) have not been compiled and reflected in totals for FY 1966 and prior years.
[d] Amounts shown for FY 1967–1969 include the applicable portion of "Budget concepts adjustments" itemized separately in the functional classification section above.

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Department of Defense

ORDER OF MAGNITUDE DATA ON COMPARATIVE OUTLAYS BY FUNCTIONAL TITLE

Selected Fiscal Years 1959–1970

(Millions of Dollars)

	FY 195	FY 1961	FY 1963	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969	FY 1970
Functional classification									
	10,545	10,651	11,386	12,662	14,407	17,054	18,988	20,317	20,456
	615	648	599	725	755	902	871	907	988
	641	786	1,015	1,384	1,591	1,830	2,095	2,441	2,720
Total	11,801	12,085	13,000	14,771	16,753	19,787	21,954	23,665	24,164
peration and Maintenance	10,378	10,611	11,874	12,349	14,710	19,000	20,578	22,106	21,841
Subtotal—Operations	22,179	22,696	24,874	27,120	31,463	38,787	42,532	45,771	46,005
rocurement									
Aircraft	7,730	5,898	6,309	5,200	6,635	8,411	9,462	8,990	8,231
Missiles	3,337	2,972	3,817	2,096	2,069	1,930	2,219	2,879	3,226
Ships	1,491	1,801	2,522	1,713	1,479	1,398	1,356	1,700	1,676
Tracked Combat Vehicles	(a)	(a)	(a)	236	202	274	457	368	293
Ordnance, Vehicles and Related Equipment	399	675	1,665	1,073	1,697	3,978	5,990	6,907	6,671
Electronics and Communications	720	1,042	1,427	897	983	1,284	1,595	1,555	1,384
Other Procurement	730	706	891	625	1,273	1,737	2,204	1,938	1,953
Tota	14,409	13,095	16,632	11,839	14,339	19,012	23,283	24,337	23,435
Research, Development, Test and Evaluation	2,866	6,131	6,376	6,236	6,259	7,160	7,747	7,545	7,805
Military Construction	1,948	1,605	1,144	1,007	1,334	1,536	1,281	1,508	1,370
Family Housing	—	—	427	619	647	482	495	630	625
Civil Defense	(*)	(*)	203	93	86	100	108	82	72
Special Foreign Currency Program	—	—	—	—	—	—	2	2	4
Working Capital Accounts (Revolving funds)	−179	−300	−1,401	−741	281	512	2,090	−1,947	−694
Military Assistance	2,340	1,449	1,721	1,229	968	873	601	548	591
Budget concepts adjustments	(b)	(b)	(b)	(b)	(b)	−130	−111	−77	−213
Total—Department of Defense	43,563	44,676	49,973	47,401	55,377	68,331	78,027	78,400	79,000
Department or Agency									
Department of the Army	9,467	10,130	11,499	11,600	14,832	20,961	25,223	24,920	25,094
Department of the Navy	11,720	12,214	14,005	13,399	16,026	19,246	22,071	22,573	22,766
Department of the Air Force	19,083	19,785	20,642	18,216	20,131	22,918	25,734	25,933	25,543
Defense Agencies/OSD	953	1,098	1,905	2,865	3,335	4,241	4,237	4,282	4,997
Civil Defense	(*)	(*)	203	93	86	100	108	82	72
Military Assistance (c)	2,340	1,449	1,721	1,229	968	865	654	610	529
Total—Department of Defense	43,563	44,676	49,973	47,401	55,377	68,331	78,027	78,400	79,000

*Less than $500,000.

[a] Amount included in entry for "Ordnance, Vehicles, and Related Equipment."

[b] Data for "Budget concepts adjustments" (applied to expenditures in the FY 1969 and FY 1970 Budget presentations) have not been compiled and reflected in totals for FY 1966 and prior years.

[c] Amounts shown for FY 1967–1970 include the applicable portion of "Budget concepts adjustments" itemized separately in the functional classification section above.

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Table No. 10 Department of Defense

MAJOR PROCUREMENT ITEM QUANTITIES

FY 1969 and 1970 Programs

	FY 1969 Program [1]	FY 1970 Program
Aircraft		
Army	1,493	1,014
Navy and Marine Corps	639	509
Air Force	990	650
Total	3,122	2,173
Helicopters	1,944	1,242
Fixed wing aircraft	1,178	931
Total	3,122	2,173
Missiles		
Army	29,530	42,896
Navy and Marine Corps	5,007	3,842
Air Force	3,982	2,400
Total—Missiles	38,519	49,138
Ships—Navy		
New Construction	8	19
Conversions	16	19
Total—Ships	24	38
Tracked Combat Vehicles		
Army	2,614	2,336
Marine Corps	5	160

[1] Includes supplemental.

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Table No. 11 Department of Defense

MILITARY AND CIVILIAN PERSONNEL

Yearend Number

	FY 1967 actual	FY 1968 actual	FY 1969 estimate	FY 1970 estimate
Military Personnel				
Army				
Officers	143,425	166,016	171,288	171,711
Enlisted	1,296,619	1,401,727	1,359,562	1,332,546
Military Academy cadets	2,378	2,443	3,350	3,643
Total—Army	1,442,422	1,570,186	1,534,200	1,507,900
Navy				
Officers	81,677	85,200	84,860	86,419
Enlisted	665,226	675,441	681,697	680,838
Naval Academy midshipmen	4,399	4,591	4,243	4,243
Aviation cadets	92	—	—	—
Total—Navy	751,394	765,232	770,800	771,500
Marine Corps				
Officers	23,592	24,555	26,010	26,058
Enlisted	261,584	282,697	287,390	288,442
Aviation cadets	93	—	—	—
Total—Marine Corps	285,269	307,252	313,400	314,500
Air Force				
Officers	135,417	139,600	133,800	135,000
Enlisted	758,648	761,507	730,926	722,049
Air Force Academy cadets	3,361	3,652	3,874	4,151
Total—Air Force	897,426	904,759	868,600	861,200
Department of Defense—Total				
Officers	384,111	415,371	415,958	419,188
Enlisted	2,982,077	3,121,372	3,059,575	3,023,875
Academy cadets and midshipmen	10,138	10,686	11,467	12,037
Aviation cadets	185	—	—	—
Total—Defense	3,376,511	3,547,429	3,487,000	3,455,100
Civilian Personnel				
Army	436,830	437,932	468,229	469,717
Navy	402,513	419,546	415,249	415,264
Air Force	323,316	315,956	325,930	322,472
Defense Agencies/OSD	75,342	74,706	72,464	72,099
Total—Defense	1,238,001	1,248,140	1,281,872	1,279,552

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DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of January 1969.

DEFENSE SUPPLY AGENCY

2—Menominee Engineering Corp., Menominee, Mich. $2,982,317. 21,990 balk decks Defense Construction Supply Center, Columbus, Ohio. DSA700-69-C-8640

6—MacShore Classic, Inc., New York, N.Y. $1,632,000. 600,000 men's cotton rip-stop poplin coats Defense Personnel Support Center, Philadelphia, Pa. DSA100-69-C 1161.

—Richard Wynn Enterprises, Inc., Knoxville, Tenn. $1,256,936. 482,800 men's cotton rip-stop poplin coats. Defense Personnel Support Center, Philadelphia, Pa DSA100-69-C-1162.

8—Armour Oil Co., San Diego, Calif. $2,425,-860. Fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0933

15—Texaco, Inc., New York, N.Y $5,460,-250. Regular and premium gasoline. Defense Fuel Supply Center, Alexandria, Va. DSA600-69-D-0976.

—Shell Oil, New York, N.Y. $1,127,271. 967,-804 quarts of aircraft lubricating oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-C-1277.

—West Point—Pepperell, Inc., New York, N.Y. $1,271,090. 701,000 linear yards of nylon ballistic cloth. Defense Personnel Support Center, Philadelphia, Pa DSA 100-69-C-1220.

16—Stauffer Chemical Co., New York, N.Y. $1,002,607. 50,112 eight-ounce cans; 845,-336 quarts, and 27,500 gallons of aircraft engine lubricating oil Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-C-1276.

—Morton House Kitchens, Inc., Nebraska City, Neb. $2,302,722. 18,323,712 cans of baked items for combat rations. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-2176.

—Rodana Research Corp., Bethesda, Md $1,050,054. 2,500,992 atropine injections Defense Personnel Support Center, Philadelphia, Pa. DSA 120-69-C-2102 ,

—George Ziegler Co., Milwaukee, Wis. $1,-344,978. 36,646,101 candy disks for combat rations. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-66-C-Z172.

17—Glenn's All American Sportswear, Inc., Amory, Miss. $1,043,125. 533,480 pairs of men's wind-resistant cotton trousers. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1215.

—Tony Downs Foods Co., St. James, Minn. $1,238,711. 3,054,048 five-and-a-quarter-ounce cans of chicken and noodles and 2,885,184 five-and-a-quarter-ounce cans of boned turkey. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-Z164.

—Tony Downs Food Co., St. James, Minn. $1,741,199. 5,523,360 cans of spiced beef. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-Z169.

—Oscar Mayer & Co., Madison, Wis. $1,-097,121 531,352 cans of spiced beef and 2,980,224 cans of beefsteak Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-Z171.

21—Oscar Mayer & Co., Madison, Wis $1,-750,780. 5,360,460 cans of sliced pork. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-Z179.

—Coastal Foods, Cambridge, Md $1,040,134. 6,107,760 cans of beans with frankfurter chunks in tomato sauce. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-Z181.

—Blue Star Foods, Inc., Council Bluffs, Iowa $1,046,102. 3,054,240 cans of beef slices and potatoes with gravy. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-Z185.

22—Menominee Engineering Corp., Menominee, Mich. $2,330,552. Eight sets of fixed floating bridges Defense Construction Supply Center, Columbus, Ohio DSA 700-69-C-8524.

23—Electro Plastic Fabrics, Inc. $3,301,500 426,000 extra lightweight, camouflage pattern ponchos with hoods Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1132.

—Otis Elevator Co., Cleveland, Ohio. $1,-352,545 226 electric forklift trucks. Defense General Supply Center, Richmond, Va. DSA 400-69-B-1887

24—Oscar Mayer & Co., Madison, Wis. $1,773,-402. 6,107,712 cans of sliced ham. Defense Personnel Support Center, Philadelphia, Pa DSA 130-69-C-Z203.

27—Tony Downs Food Co., St. James, Minn. $1,238,630. 3,053,856 five-and-one-quarter-ounce cans of chicken and noodles, and 2,884,992 five-and-three-quarter-ounce cans of boned turkey. Defense Personnel Support Center, Philadelphia, Pa DSA 130-69-C-Z216.

—Franklin Clothes, Inc., Woodbine, N.J $1,033,800. 60,000 men's tropical wool polyester coats Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1248.

—Blue Star Foods, Inc., Council Bluffs, Iowa. $1,045,854. 3,053,520 cans of beef slices and potatoes and gravy. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-Z211.

29—Johnson & Johnson, New Brunswick, N.J. $1,197,122. 439,736 packages of surgical sponges. Defense Personnel Support Center, Philadelphia, Pa. DSA 120-69-C-2203.

—Guy H. James Industries, Inc., Midwest City, Okla. $1,177,374. 1,212,880 cotton sateen shirts. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1329.

—Bonham Mfg. Co., Bonham, Tex. $1,181,-710. 355,000 coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1361

—Allen Overall Co., Monroe, N.C. $1,509,-600. 510,000 coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1362.

—Burgess Mfg. Co., Cartersville, Ga. $1,-377,550. 459,880 coats. Defense Personnel Support Center, Philadelphia, Pa. DSA

DEPARTMENT OF THE ARMY

2—Bogue Electric Mfg., Co., Paterson, N.J. $2,049,116 (contract modification). Generator sets Mobility Equipment Command, St Louis, Mo. DA 11-184-AMC-00961 (T).

—Bolt, Beranek & Newmann, Inc., Cambridge, Mass. $1,077,727. Design and installation of interface message processors. Defense Supply Service, Washington, D.C. DA HC15-69-C-0179.

3—Talley Industries, Inc., Mesa, Ariz. $1,-682,350. Metal parts for 4.2-inch projectiles Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0328.

—Union Carbide Corp., New York, N.Y. $2,994,967. Dry batteries. Charlotte, N.C. Electronics Command, Philadelphia, Pa. DA AB05-69-C-3221.

—Standard Container Co., Montclair, N.J. $2,423,742 Small arms ammunition packing boxes. Homerville, Ga. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0308.

—Youngstown Steel Door Co., Elmira, N.Y $2,371,731. Small arms ammunition packing boxes, Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0307.

6—System Development Corp., Santa Monica, Calif. $3,461,524 (contract modification). Continuation of research and development on the solution of the computer-aided command problem. Defense Supply Service, Washington, D.C. DA HC15-67-C-0149.

—Bell Helicopter Co., Fort Worth, Tex. $2,-435,625 (contract modification). UH-1H helicopters. Hurst, Tex. Aviation Materiel Command, St. Louis, Mo. DA AJ01-69-C-0028.

—Whirlpool Corp., Evansville, Ind. $1,971,-913. 152mm canisters (XM626). Picatinny Arsenal, Dover, N J. DA AA21-69-C-0363.

—Northrop Corp., Anaheim, Calif. $1,475,-000. 152mm canisters (XM626). Picatinny Arsenal, Dover, N.J. DA AA21-69-C-0362.

—Northeast Construction Co. of West Virginia, Albuquerque, N.M. $2,642,348. Construction of 160 family housing units for NCOs at Fort Jackson, S.C. Engineer Dist., Savannah, Ga. DA CA21-69-C-0031.

—AVCO Economics Systems Corp., Washington, D.C. $2,660,595. Renovation and production of ammunition components, and for installation of equipment at Glasgow AFB, Mont. Fort Detrick, Md. DA AA13-69-C-0064.

7—Martin K. Eby Constrcution Co., Wichita, Kan. $2,783,625. Construction work and installation of government-furnished power equipment at the Stockton Reservoir, Sac River, Cedar County, Missouri, Project. Engineer Dist., Kansas City, Mo. DA CW 41—69-C-0057.

8—Batesville Mfg. Co., Batesville, Ark. $1,-211,600 (contract modification). Metal parts (M904E2) for fuzes for 750-lb. bombs. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0069.

—Delco Remy Div., General Motors Corp., Anderson, Ind. $2,691,979. 12-volt storage batteries for general vehicle application Anaheim, Calif. Tank Automotive Command, Warren, Mich. DA AE07-69-C-1946.

—**Philco Ford Corp.**, Willow Grove, Pa. $1,935,263 (contract modification). Operation and maintenance services in Saigon and at Okinawa sites for one year. Electronics Command, Fort Monmouth, N.J. DA 36-039-AMC-05589 (E).

9—**Temco, Inc.**, Nashville, Tenn $2,387,000 Metal parts for 4 2-inch projectiles Army Procurement Agency, Chicago, Ill DA AA09-69-C-0082

—**Honeywell, Inc.**, North Hopkins, Minn $1,316,250 (contract modification). Bomblet fuzes. New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill DA AA09-68-C-0490

—**Technical Operations**, Burlington, Mass. $1,300,000 (contract modification). 1,333 man-months of scientific, technical and support effort for studies for the Combat Development Command, Fort Belvoir, Va Alexandria, Va. Army Procurement Agency Oakland, Calif. DA AG05-67-C-0547.

0—**Goodyear Tire & Rubber Co**, Akron, Ohio. $1,131,488 (contract modification). Pneumatic tires for 2½-ton and 5-ton trucks Gadsden, Ala. Tank Automotive Command, Warren, Mich. DA AE07-69-C-1273.

—**Maremont Corp.**, Saco, Maine. $3,183,648. M60 machine guns, barrel assemblies and bi-pods Army Weapons Command, Rock Island, Ill. DA AF03-69-C-0050.

—**United Aircraft**, Windsor, Locks, Conn. $1,658,505. Propeller systems for OV-1D aircraft, related data reports and technical publications. Aviation Systems Command, St. Louis, Mo. NO0383-67-A-1901.

—**Honeywell, Inc.**, Hopkins, Minn. $1,515,000. Delay plungers with point detonating fuzes for 105mm projectiles. New Brighton, Minn. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0191.

—**Standard Products**, Cleveland, Ohio. $1,602,933. Track shoe assemblies for M114 personnel carriers. Port Clinton, Ohio. Tank Automotive Command, Warren, Mich. DA AE07-69-C-2023.

—**Hughes Tool Co.**, Culver City, Calif. $1,043,169 (contract modification). Product improvement on the OH-6A helicopter. Aviation Systems Command, St. Louis, Mo. DA AJ01-68-C-1123.

—**Chrysler Corp.**, Huntsville, Ala. $2,943,550. Second source production of the TOW missile, Army Missile Command, Huntsville, Ala. DA AH01-69-C-0928

14—**Olin Mathieson Chemical Corp.**, East Alton, Ill. $9,222,528. 7.62mm, 5.56mm and 20mm ammunition propellant. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0318.

—**Motorola, Inc.**, Scottsdale, Ariz. $2,000,000. Classified electronics equipment. Electronics Command, Fort Monmouth, N.J.

—**North American Rockwell**, Anaheim, Calif. $1,080,000. Classified work. Sentinel Systems Command, Huntsville, Ala. DA HC-60-69-C-0046.

15—**Fruin-Colnon**, St. Louis, Mo. $3,164,075. Construction of three additional wings to the existing composite medical facility at Scott AFB, Ill. Engineer Dist., Chicago, Ill. DA CA23-69-C-0056.

—**Hayes Albion Corp.**, Albion, Mich. $2,052,000. Metal parts for 2.75-inch rocket warheads. Albion and Hillsdale, Mich. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0332.

—**Uniroyal, Inc.**, Detroit, Mich. $1,795,705 (contract modification). Pneumatic tires for 2½-ton and 5-ton trucks. Los Angeles, Calif.; Chicopee Falls, Mass. and Detroit, Mich. Tank Automotive Command, Warren, Mich. DA AE07-69-C-1274.

—**Fairchild Camera**, Copiague, N.Y. $1,403,325. Production engineering of ZM570 fuzes. Picatinny Arsenal, Dover, N.J. DA AA21-69-C-0348.

—**Parsons Mfg. & Stamping Co.**, Cordova, Tenn. $1,245,438. Rotating discs for 4.2-inch obturating assemblies. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0329.

16—**Texas Instruments, Inc.**, Dallas, Tex. $1,500,000 (contract modification). Classified work. Electronics Command, Fort Monmouth, N.J.

17—**Ranger Construction Co.**, Huntsville, Ala. $2,780,533. Construction of 170 family housing units with supporting utilities at Redstone Arsenal, Ala. Engineer Dist., Mobile, Ala. DA CA01-69-C-0022.

—**J. W. Bateson**, Dallas, Tex. $7,628,400. Construction of 448 family housing units with supporting utilities at Fort Gordon, Ga. Engineer Dist., Savannah, Ga. DA CA21-69-C-0055.

—**Algernon Blair, Inc.**, Montgomery, Ala $2,820,000 Construction of a reception processing building and supporting utilities at Fort Jackson, S C Engineer Dist, Savannah, Ga. DA CA21-69-C-0054

—**Southwide Construction Co.**, Augusta, Ga $2,084,858 Construction of 120 family housing units and supporting utilities at Fort Stewart, Ga Engineer Dist, Savannah, Ga DA CA21-69-C-0050

21—**Olin Mathieson Chemical Corp.**, New Haven, Conn. $1,173,384 (contract modification) 45 cal. cartridges East Alton, Ill. and New Haven. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0220

22—**Morrison Knudsen Co**, New York, N.Y $2,213,857. Phase II construction of Boston Perimeter Acquisition Radar for Sentinel System Command Sharpeners Pond Site, Mass. Engineer Dist, Huntsville, Ala DA CA87-69-C-0010

—**Packard Bell Electronics Corp.**, Newbury Park, Calif. $1,262,810 Transponder test sets (AN/AMP-123 (V) 122M3) for radio receivers. Army Procurement Agency, Pasadena, Calif. DA AG07-69-C-0430.

23—**Firestone Tire & Rubber Co.**, Akron, Ohio. $5,171,754 Track shoe assemblies for M48 and M60 tanks Tank Automotive Command, Warren, Mich. DA AE07-69-C-2209.

—**Southwest Truck Body Co.**, St. Louis, Mo. $1,135,083. Shop equipment for general purpose repair. West Plains, Mo Mobility Equipment Command, St. Louis, Mo DA AK01-68-C-2287.

—**Western Electric**, New York, N.Y. $2,718,674 (contract modification). Task and skill analysis for the Sentinel Training Program. Sentinel Systems Command, Huntsville, Ala. DA HC-60-69-C-0010.

—**Chamberlain Mfg. Corp.**, Elmhurst, Ill $3,752,089 (contract modification). 105mm Cartridge cases (M1481) Burlington, N.J. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0182.

—**Franchi Construction Co.**, Newton, Mass. $6,822,000. Construction of a 116-bed Army hospital at Fort Devens, Ayer, Mass. New England Division, Corps of Engineers. DA CA33-69-C-0024.

—**Lockheed Aircraft Service Corp.**, Lake Charles, La. $1,846,000. Inspection, and repair as necessary, of 130 UH-1D aircraft. Aviation Systems Command, St Louis, Mo DA AJ01-69-C-0029.

—**E. I. DuPont de Nemours & Co.**, Wilmington, Del. $2,255,400. 12,600,000 pounds of flaked TNT. Barksdale, Wis. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0327.

24—**Peace Corp.**, Memphis, Tenn. $5,008,400 (contract modification). White Star parachute signals (M127A1). Camden, Ark. and Memphis, Tenn. Picatinny Arsenal, Dover, N.J. DA AA21-69-C-0327.

—**AAI Corp.**, Cockeysville, Md. $1,880,000. AN/MPQ-P1 simulators for the Nike Hercules missile system. Army Missile Command, Huntsville, Ala. DA AH01-69-C-1002.

—**Matich Bros.**, Rialto, Calif. $1,048,300. Construction of an airfield parking apron at Norton AFB, Calif. Engineer Dist, Los Angeles, Calif. DA CA09-69-C-0113.

—**Brunswick Corp.**, Sugargrove, Va. $3,520,080. Riot control agent (CS) filled 35mm cartridge launchers, 16-tubes (E-8). Edgewood Arsenal, Md. DA AA15-69-C-0349.

—**Atlantic Research Corp.**, West Hanover, Mass. $3,032,778. CS filled 35mm cartridge launchers, 16 tubes (E-8). Edgewood Arsenal, Md. DA AA15-69-C-0350.

—**Northern Nortronics**, Hawthorne, Calif. $1,303,581. AN/ASH-19 voice warning systems for CH-47 Chinook and OV-1 Mohawk helicopters. Electronics Command, Fort Monmouth, N.J. DA AB07-68-C 0467.

—**Keystone Mfg. Corp.**, Dorchester, Mass. $1,426,306. Delay plungers for 105mm shells. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0206.

—**Harvey Aluminum**, Torrance, Calif. $1,580,317. 40mm cartridge cases. Army Procurement Agency, Pasadena, Calif. DA AA09-69-C-0178.

—**James Leck Co.**, Minneapolis, Minn. $1,674,000. Construction of a primer mix facility at New Brighton, Minn. Engineer Dist., Chicago, Ill. DA CA23-69-C-0047.

27—**Kollsman Instrument Corp.**, Elmhurst, N.Y. $2,538,621. Firing devices for M57 mines. Bridgeport, Conn. Picatinny Arsenal, Dover, Del. DA AA21-69-C-0422.

—**Norris Industries**, Vernon, Calif $1,827,131 105mm cartridge cases Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0337

—**Martin Marietta Corp.**, Orlando, Fla. $1,600,000 (contract modification) A Pershing improvement program Army Missile Command, Huntsville, Ala DA AH01-19-C-0863

28—**Bell Aerospace Corp.**, Fort Worth, Tex. $1,810,715 Rotary wing blades. DA AJ01-68-A-0022. $1,470,490 Main tail rotor hubs. DA AJ01 68 A-0022 Hurst, Tex. Aviation Systems Command, St Louis, Mo.

—**Douglas & Lomason Co.**, Columbus, Ga. $1,343,792 (contract modification). Fragmentation bombs, and adapter clusters for 100-lb. fragmentation bombs Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0126

—**Susquehanna Corp.**, West Hanover, Mass. $1,125,210 2 75-inch motor igniters. Picatinny Arsenal, Dover, N J. DA AA21-69-C-0423

29—**Goodyear Tire & Rubber Co.**, Akron, Ohio. $5,843,806 T130 track shoe assemblies used on M113A1 personnel carriers. St Mary's, Ohio. Tank Automotive Command, Warren, Mich. DA AE07-69-C-2264

—**Sun Battery Co**, Santa Ana, Calif $1,436,444. Storage batteries. Tank Automotive Command, Warren, Mich DA AE07-69-C-2218.

—**Goodyear Tire & Rubber Co.**, Akron, Ohio. $1,248,008. T84E1 track shoe assemblies for M53 howitzers. St. Mary's, Ohio. DA AE07-69-C-2259

30—**Remington Arms, Inc.**, Bridgeport, Conn. $22,274,870. Manufacture of small arms ammunition Independence, Mo. Ammunition Procurement & Supply Agency, Joliet, Ill DA 49-010-AMC-00003 (A).

—**Olin Mathieson Chemical Corp.**, New York, N.Y $14,127,745. Load, assemble and pack propellants and related ammunition components. Charlestown, Ind. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00007 (A).

—**Federal Cartridge Corp.**, Minneapolis, Minn $13,236,510. Production of small arms ammunition. New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 36-038-AMC-01099 (A).

—**Day & Zimmermann, Inc.**, Philadelphia, Pa. $10,274,955. Load, assemble and pack ammunition. Texarkana, Tex. Ammunition Procurement & Supply Agency, Joliet, Ill DA 11-173-AMC-00114 (A).

—**Firestone Tire & Rubber Co.**, Ravenna, Ohio. $5,273,420. Load, assemble and pack ammunition and related components. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00065 (A)

—**Eastman Kodak Co.**, Kingsport, Tenn. $1,079,736. Manufacture explosives. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00035 (A).

—**Kaiser Jeep Corp.**, Toledo, Ohio. $12,985,294 (contract modification). 2½-ton trucks. South Bend, Ind. Project Manager, General Purposes Vehicles, Michigan Army Missile Plant, Warren, Mich. DA AE06 68-C-0007.

—**Continental Motors**, Muskegon, Mich. $3,386,099 (contract modification). Three and six horsepower military standard engines. Milwaukee, Wis. Mobility Equipment Command, St. Louis, Mo. DA 23-195-AMC-00808 (T).

—**Page Communications Engineers**, Washington, D.C. $2,183,615. Recoverable microwave terminals for use with the Integrated Wide Band Communications System. Electronics Command, Fort Monmouth, N.J. DA AB07-69-C-0107.

—**Caronia Construction Co.**, Winchester, Mass. $1,683,000. Construction of a special computation laboratory at L. G. Hanscom Field, Mass. New England Engineer Div., Waltham, Mass. DA CA33-69-C-0025.

—**Raytheon Co.**, Norwood, Mass. $1,428,940 (contract modification). Multiplexers and spare parts kits. North Dighton, Mass. Electronics Command, Philadelphia, Pa. DA AB05-69-C-1012.

—**AVCO Corp.**, Richmond, Ind. $1,124,750. Metal parts for adapter boosters for 750-lb. bomb tail fuzes. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0348.

31—**Motorola, Inc.**, Scottsdale, Ariz. $7,587,000. Radar surveillance sets for OV-1D Mohawk aircraft. Electronics Command,

Fort Monmouth, N.J. DA AB07-68-C-0419
—Texas Instruments, Inc., Dallas, Tex. $5,-721,660 (contract modification). Classified work Mobility Equipment Research & Development Command, Fort Belvoir, Va. DA AK02-68-C-0541.
—R&D Constructiors, Inc., Park Ridge, Ill. $3,725,429 Design and construction of a fuel supply system and a field maintenance hangar for the C-5A aircraft. Dover AFB, Del. Engineer Dist., Baltimore, Md. DA CA31-69-C-0050.
—General Electric, Burlington, Vt. $3,106,-652. Aircraft machine guns. Springfield, Mass. and Burlington, Vt. Army Weapons Command, Rock Island, Ill DA AF03-69-C-0042.
—Northrop Nortronics, Hawthorne, Calif $2,549,666 (contract modification). Voice warning systems for Chinook and Mohawk helicopters. Electronics Command, Fort Monmouth, N.J. DA AB07-68-C-0467.
—Scoville Mfg. Co., Waterbury, Conn. $2,-410,337. Bomblet fuzes. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0141.
—Bell Aerospace Corp., Tucson, Ariz. $1,-787,074 (contract modification). Services required for the continuous operation, maintenance, future development and modernization of the Electro Magnetic Environmental Test Facility, Vail, Ariz. Procurement Div., Army Garrison, Fort Huachuca, Ariz. DA 02-086-AMC-0212 (R).
—Sperry Rand Corp., Phoenix, Ariz. $1,267,-302. Gyromagnetic compass sets. Army Procurement Agency, Pasadena, Calif. DA AG07-69-C-0436.
—Aerojet General Corp., Downey, Calif $1,-214,986. 2.75-inch rocket warheads. Fullerton, Calif. Army Procurement Agency, Pasadena, Calif. DA AA09-69-C-0134.
—Waukesha Motor Co., Waukesha, Wis $1,-157,870. Generator sets. Mobility Equipment Command, St. Louis, Mo. DA AK 01-69-C-5228.
—Triangle Electronic Mfg. Co., Poughkeepsie, N.Y. $1,094,401 Cable assemblies and adapter assemblies. Electronics Command, Philadelphia, Pa. DA AB05-69-C-1023.
—Temco, Inc., Nashville, Tenn. $1,071,084 (contract modification). Metal parts for 106mm projectiles. Army Procurement Agency, Chicago, Ill. DA AG11-69-C-0224.
—AVCO Corp., Richmond, Ind. $1,056,645. Metal parts for hand grenades. Army Procurement Agency, Cincinnati, Ohio. DA AA09-69-C-0258.
—Mason & Hanger—Silas Mason Co., New York, N.Y. $11,569,505. (contract modification). Load, assemble and pack bombs and ammunition items, and for support services Grand Island, Neb. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-68-C-0383.
—Mason & Hanger—Silas Mason Co., New York, N.Y. $7,761,807 (contract modification). Load, assemble and pack ammunition items and components. Burlington, Iowa. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-68-C-0468.
—AVCO Corp., Richmond, Ind. $6,001,016. Classified components of the 155mm projectile. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0339.
—Olin Mathieson Chemical Corp., New York, N.Y. $4,493,226 (contract modification). Production of propellants and for support services. Baraboo, Wis. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0014.
—Hercules, Inc., Wilmington, Del. $1,113,-695 (contract modification). Manufacture of propellants. Lawrence, Kan. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00042 (A).
—Chamberlain Mfg. Corp., Elmhurst, Ill. $1,089,811 (contract modification). Body assemblies for 8-inch projectiles. Scranton, Pa. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-00614 (A).
—EMCO Porcelain Enamel Co., Port Chester, N.Y. $3,800,000. Ammunition boxes. Frankford Arsenal, Philadelphia, Pa. DA AA-25-69-C-0236.
—Remington Arms Corp., Bridgeport, Conn. $2,900,000 (contract modification). 7.62mm linked ammunition. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0088.
Olin Mathieson Chemical Corp., New Haven, Conn. $2,167,680 (contract modification). 7.62mm clipped ammunition. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0090.
Olin Mathieson Chemical Corp., East Alton, Ill $1,647,046 (contract modification) 7.62mm linked ammunition Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0089.
—Stevens Mfg. Co., Ebensburg, Pa $3,549,-550. 1½-ton trailers to transport potable water. Tank Automotive Command, Warren, Mich. DA AE07-69-C-1461.
—General Motors, Warren, Mich. $3,199,290 M-60 transmission assemblies Tank Automotive Command, Warren, Mich. DA AE07-68-C-2806.
—Chrysler Motors, Warren, Mich. $1,600,-177. One-ton cargo trucks and one-ton ambulances. Tank Automotive Command, Warren, Mich DA AE07-69-C-0771.
—Charles Otsuka, Inc., Honolulu, Hawaii. $1,298,627. Construction of an airmen's dormitory at Hickam AFB, Hawaii. Engineer Dist., Honolulu, Hawaii. DA CA83-69-C-0014.
—Christianson-Kaber-Kief & Associates, Inc., and B-E-C-K Construction Co., Seattle, Wash. $1,709,020. Construction of an airmen's dormitory and repairs to existing buildings at Shemya AFS, Alaska Engineer Dist., Anchorage, Alaska. DA CA85-69-C-0036.

DEPARTMENT OF THE NAVY

2—Lockheed Aircraft Corp., Burbank, Calif. $1,500,000. Sustaining effort for the VSX weapon system. Naval Air Systems Command. N00019-69-C-0354.
—General Dynamics Corp., San Diego, Calif. $1,499,915. Sustaining effort for the VSX weapon system. Naval Air Systems Command. N00019-69-C-0338.
—Varo, Inc., Garland, Tex. $1,473,710. MAU 9A/A ejector bomb racks. Naval Air Systems Command. N00019-69-C-0320.
—Woods Hole Oceanographic Institution, Woods Hole, Mass $1,191,848. Additional oceanographic studies. Office of Naval Research.
3—General Dynamics Corp., Pomona, Calif. $11,618,136. FY 1969 production of Standard Arm missiles Naval Air Systems Command. N00019-69-C-0336.
—Computer Sciences Corp., El Segundo, Calif. $4,807,178 Automatic data processing, data reduction, data assessment and related services as ordered by the Naval Undersea Warfare Center, Pasadena, Calif. Navy Purchasing Office, Los Angeles, Calif. N00123-69-C-0290.
—General Electric Co., Washington, D.C. $1,-412,135. Polaris MK1 and MK2 guidance system tactical engineering. Pittsfield, Mass. Strategic Systems Project Office. N00030-69-C-0153.
—Vocaline Co. of America, Saybrook, Conn. $1,336,447. Sonobuoy, bathythermograph transmitter set and underwater sound signal testing. South Bristol, Maine. Naval Air Systems Command. N00019-69-C-0179.
—Collins Radio, Cedar Rapids, Iowa. $1,036,-867. Launch control sub-systems and engineering support in the SECT program. Naval Ordnance Laboratory, White Oak, Silver Spring, Md. N60921-69-C-0121.
—Dayton Electronic Products Co., Dayton, Ohio. $2,156,498. Manufacture of shipboard transceivers. Naval Electronic Systems Command. N00039-C-1553.
6—PRD Electronics, Inc., Jericho, N.Y. $10,-231,000. VAST (Versatile Avionics Shop Test Equipment) test stations for A-7E aircraft. Naval Air Systems Command. N00019-69-C-0384.
—Todd Shipyards Corp., San Pedro, Calif. $1,194,551. Regular overhaul of the oiler USS Guadalupe (AO-32). Supervisor of Shipbuilding, Conversion and Repair, 11th Naval Dist., Long Beach, Calif. N62791-69-B-0032 (Job Order 11ND-112-69).
7—Radio Corp. of America, Van Nuys, Calif. $1,974,750. MK 93 proximity fuzes for 5-inch Zuni rockets. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0202
—Bethlehem Steel Corp., East Boston, Mass. $1,995,215. Topside alteration and repair of the oiler USS Severn (AO-61) Supervisor of Shipbuilding, Conversion and Repair, 1st Naval Dist., Boston, Mass. IFB N62665-69-B-33 (Job Order No. 35).
—Collins Radio Co., Cedar Rapids, Iowa. $2,-389,980. Classified Electronic Countermeasure (ECM) equipment for the Navy and the Air Force Naval Air Systems Command N00019-69-C-0180.
8—Raytheon Co., Lexington, Mass. $31,177,-850 Guidance and control groups for Sparrow III missiles for the Navy and Air Force Lowell, Mass ; Bristol, Tenn. and Oxnard, Calif. Naval Air Systems Command, N00019-69-C-0358.
9—Sperry Rand Corp., Syosset, N.Y. $5,-800,000. Poseidon navigation trainers conversion at the Guided Missile School, Dam Neck, Va , and at the Fleet Ballistic Missile Submarine Training Center, Charleston, S.C ; and for retrofit of Polaris navigation trainers at the Fleet Submarine Training Facility, Pearl Harbor, Hawaii Strategic Systems Project Office. N00030-69-C-0012.
—Sperry Gyroscope Div., Sperry Rand Corp., Great Neck, N.Y. $1,000,000. Fifteen Ships Inertial Navigation Systems (SINS). Naval Ship Systems Command. N00024-69-C-5290.
10—Curtiss Wright Corp., Wood-Ridge, N.J. $1,508,371. Spare parts for R1820/80/-82/84/86 aircraft engines. Aviation Supply Office, Philadelphia, Pa. F41608-69-A-0057-GB35.
—Banner Metals, Inc., Compton, Calif. $1,-110,871. MK 11, MOD 1, pallet adapters, and spare parts. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0214.
13—Stromberg Datagraphics, San Diego, Calif. $2,581,715. Airborne tactical display systems. Naval Air Systems Command. N00019-69-C-0302.
—Grumman Aircraft Engineering Corp., Bethpage, N.Y. $2,565,300. Building maintenance at the Naval Weapons Industrial Reserve Plant. Naval Air Systems Command. N00019-69-C-9020.
—Sanders Associates, Inc., Nashua, N.H. $1,840,539 (contract modification). Repair and modification of electronic countermeasure equipment. Naval Air Systems Command. N00019-67-C-0614.
—Systron-Donner Corp., Concord, Calif. $1,-332,577. Counting type accelerometer groups. Naval Air Systems Command. N00019-69-C-0374.
14—McDonnell Douglas Corp., Long Beach, Calif. $7,101,216 (contract modification) Extension of long lead time effort and materials for FY 1969 procurement of TA-4F aircraft. Naval Air Systems Command. N00019-67-C-0170.
15—University of Rochester, Rochester, N.Y. $9,025,736. Research of problems associated with the mission of the Navy Rochester, N.Y. and Arlington, Va. Office of Naval Research.
—Maxon Electronics Corp., Macon, Ga. $1,-869,449. MK 83, MOD O, base fuses for 5-inch 38-cal. projectiles. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00-104-69-C-0142.
—Sanders Associates, Nashua, N H. $1,861,-757. Classified electronics equipment Naval Air Systems Command. N00019-69-C-0331.
—General Dynamics, Groton, Conn. $2,000,-000. Advanced planning and design of conversion support for SSBN submarines. Naval Ship Systems Command. N00024-69-C-0271.
—Uniflite, Inc., Bellingham, Wash. $1,035,-165. Twenty-two 31-foot patrol boats. Naval Ship Systems Command. N00024-69-C-0276.
—Sperry Rand Corp., Syosset, N.Y. $1,000,-000. Nuclear submarine inertial navigation subsystems components. Naval Ship Systems Command. N00024-69-C-5300.
16—Magnavox Co., Fort Wayne, Ind $6,542,-299. Sonobuoys. Naval Air Systems Command. N00019-69-C-0381.
—Vitro Corp., Fort Walton Beach, Fla. $2,-145,127. Shipboard hydrographic data acquisition systems. Naval Oceanographic Office, Suitland, Md. N62306-69-C-0095.

—LTV Aerospace Corp., Dallas, Tex. $1,200,000. Facilities maintenance at the Naval Weapons Industrial Reserve Plant, Dallas, Tex. Naval Air Systems Command N00019-69-C-0004.

—Ames-Ennis, Inc., Baltimore, Md $5,504,000 Construction of 300 family housing units at the Naval Air Training Center, Patuxent River, Md. Chesapeake Div , Naval Facilities Engineering Command, Washington, D.C. N62477-68-B-0056.

—Iannuccillo Construction Co., Central Falls, R.I. $5,244,000. Construction of 300 family housing units at the Naval Complex, Newport, R.I. Northeast Div., Naval Facilities Engineering Command, Boston, Mass. N62464-67-C-0419.

—Pacific Venture, Inc., Seattle, Wash. $1,557,160. Construction of 100 family housing units at the Naval Shipyard, Bremerton, Wash. Northwest Div , Naval Facilities Engineering Command, Seattle, Wash. N62476-69-C-0052.

17—General Dynamics, Groton, Conn. $10,779,863. Materials and equipment required for regular overhaul and C3 Poseidon missile conversion of nuclear submarines. Naval Ship Systems Command. N00024-68-C-0203 Mod. PZ07.

22—Morgen & Oswood Consuction Co. and Lowe Construction Co., Great Falls, Mont. $1,894,400. Construction of a 500-man receiving barracks and a 350-man staff barracks at the Naval Training Center, Orlando, Fla. Southeast Div., Naval Facilities Engineering Command, Orlando, Fla. N62467-67-C-0296.

—Hazeltine Corp., Little Neck, N Y. $1,575,000. Classified electronic equipment. Naval Air Systems Command. N00019-69-C-0396.

—D. R. Kincaid Co., Honolulu, Hawaii. $1,422,819. Construction of five 1-story reinforced concrete buildings to replace typhoon damaged or destroyed facilities at the Air Force Station, Wake Island. Mid-Pacific Div., Naval Facilities Engineering Command, Honolulu, Hawaii. N62471-69-B-0321.

—University of Alaska, College, Alaska. $1,210,000. Additional research in Arctic problems. Office of Naval Research.

—RCA, Van Nuys, Calif. $1,130,040. MK 25, MOD 0, monitor fuses Navy Ships Parts Control Center, Mechanicsburg, Pa. N-00104-69-C-0222.

—Meadow Gold Dairies, Hawaii Ltd., Honolulu, Hawaii. $1,060,420. Dairy products for general mess issue. Navy Supply Center, Pearl Harbor, Hawaii. N00604-69-D-0248.

23—Sanders Associates, Nashua, N.H. $8,467,019. Sonobuoys. Naval Air Systems Command. N00019-69-C-0397.

—Honeywell, Inc., Minneapolis, Minn. $2,080,549. Altimeter sets and associated equipment. Naval Air Systems Command N00019-69-C-0388.

24—McDonnell Douglas Corp., St. Louis, Mo. $12,000,000. Long lead time effort and materials to support procurement of F-4E and RF-4C aircraft for the Air Force. Naval Air Systems Command. N00019-68-C-0495.

—Diesel Service Center, Inc., Long Beach, Calif. $1,800,000. Overhaul and repair of engines for landing craft and small boats. Navy Purchasing Office, Los Angeles, Calif. N00123-69-C-1113.

27—Norfolk Shipbuilding & Drydock Corp., Norfolk, Va. $1,062,000. Regular overhaul of the landing ship, tank USS Walworth County (LST-1164). Supervisor of Shipbuilding, Conversion and Repair, Fifth Naval Dist., Norfolk, Va. N62678-67-C-0018.

28—Collins Radio Corp., Cedar Rapids, Iowa. $4,013,421. AN/ARC-51 aircraft radio sets. Aviation Supply Office, Philadelphia, Pa. N00383-69-C-2088.

—Stewart Warner Electronics, Chicago, Ill. $1,321,905. Components and lower assemblies of AN/APG-53A ground clearance radar equipment for A-4 aircraft. Aviation Supply Office, Philadelphia, Pa. N-00383-69-C-2016.

—Lear-Siegler, Inc., Grand Rapids, Mich. $1,281,782. Components of the AJB-3 loft bomb release computer set. Aviation Supply Office, Philadelphia, Pa. N00383-69-C-2017.

—North American Rockwell Corp., McGregor Tex. $1,253,632 (contract modification). Rocket motors for Shrike and Sparrow missile. Naval Air Systems Command. N00019-69-C-0215.

—Sperry Rand Corp., St. Paul, Minn. $1,075,864. Naval Tactical Data System design, engineering, programming and documentation for DLG(N) 36 now under construction at Newport News, Va Naval Ship Systems Command N00024-69-C-1125.

29—General Electric, Washington, D.C $1,934,000. MK 88 fire control systems and related materiels for use on Phase II Poseidon missiles. Pittsfield, Mass Strategic Systems Project Office. N00030-66-C-0166

—Lansdowne Steel & Iron Corp., Morton, Pa. $2,888,172. MK 51 projectiles. Navy Ships Parts Control Center, Mechanicsburg, Pa N00104-69-C-0258

30—McDonnell Douglas Corp., St Louis, Mo. $16,800,000 (contract modification) F-4J and RF-4B aircraft. Naval Air Systems Command. N00019-68-C-0495

—RCA, Van Nuys, Calif. $2,200,000. Classified electronic counter-measures equipment. Naval Ship Systems Command. N00024-69-C-1194.

—Kaman Corp., Bloomfield, Conn. $1,255,652 (contract modification). Modification of UH-2A/B helicopters to a twin engine configuration designated UH-2C Naval Air Systems Command. N00019-69-C-0066.

31—Goodyear Aerospace Corp., Akron, Ohio $10,688,390. SUBROC missiles. Naval Ordnance Systems Command. N00017-69-C-1407.

—Raymond Engineering, Inc., Middletown, Conn. $3,560,850. MK 346, Mod O, bomb fuzes. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0232.

—Columbia University, New York, N.Y. $1,606,035. Marine geophysics research. Office of Naval Research.

DEPARTMENT OF THE AIR FORCE

2—Sylvania Electric Products, Inc., Needham Heights, Mass $3,000,000 (contract modification). Support of ground electronics systems Space & Missile Systems Organization (AFSC), Los Angeles, Calif. F04694 67-C-0050.

3—Boeing Co., Seattle, Wash. $5,000,000. Force modernization program of Minuteman Wing III. Minot, N.D. Space & Missile Systems Organization (AFSC), Los Angeles, Calif. F04701-68-C-0288.

—McDonnell Douglas Corp., Santa Monica, Calif. $1,200,000. Study and fabrication of improved heat shields and nose tips for advanced ballistic missile reentry systems. Space & Missile Systems Organization (AFSC), Los Angeles, Calif. F04701-68-C-0288.

—Boeing Co., Seattle, Wash. $1,112,750. Installation and checkout of UHF antennae and radios for Minuteman Wing VI. Grand Forks AFB, N.D. Space & Missile Systems Organization (AFSC), Los An- [illegible] A-2019.

—Battelle Memorial Institute, Columbus, Ohio. $1,000,000. Continued operation of the Defense Metals Information Center. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33615-69-C-1343.

6—Litton Systems, Inc., Woodland Hills, Calif. $3,750,507. Production of instrument spare parts to support the LN16 inertial navigation system applicable to RC-135 and DC-130 aircraft. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F04606-68-A-0147.

—United Aircraft Corp., East Hartford, Conn. $1,078,564. Production of modification kits applicable to J57 and J59 aircraft engines. San Antonio Air Materiel Area. (AFLC), Kelly AFB, Tex. N383-6900A.

—Greenhut Construction Co., Pensacola, Fla. $1,405,000. Construction of 100 family housing units. Biloxi, Miss Keesler AFB, Miss. F22600-69-C-0156.

7—Electronic Communications, Inc., St. Petersburg, Fla. $1,225,000. Engineering, fabrication of kits, data and spares for UHF airborne teletype terminals for EC-135 aircraft. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla F34601-69-C-1333.

—Lasko Metal Products, Inc., West Chester, Pa. $3,238,430. Production of bomb fin assemblies Armament Development & Test Center, (AFSC), Eglin AFB, Fla. F-08635-69-C-0025.

9—United Aircraft Corp., Hartford, Conn. $1,292,497. Production of forgings for J57 aircraft engines San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex N383-69000A

10—Lockheed Aircraft, Marietta, Ga. $37,083,220. C-130E aircraft, spare parts, and aerospace ground equipment. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0249 (P001).

—Westinghouse Electric, Baltimore, Md. $1,885,000. Classified space hardware. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif F04701-68-C-0269.

—General Electric, West Lynn, Mass. $5,500,000 CY 1969 component improvement for J85/T58 aircrat engines Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0385.

13—Martin Marietta Corp., Baltimore, Md. $2,689,308. Production of modification kits for F101 aircraft. Middle River, Md. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-1141.

—U.S. Steel, Pittsburgh, Pa. $2,390,040. Production of bomb component. McKeesport, Pa .Armament Development Test Center, Eglin AFB, Fla. F09635-69-C-0026.

—Philco Ford Corp., Palo Alto, Calif. $3,918,639. Operation and maintenance of a tracking station at Grenier AFS, N.H. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0056.

—Radiation, Inc., Melbourne, Fla. $1,086,000. Production of communications equipment. Palm Bay, Fla. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0020.

—Dell Industries, Waycross, Ga. $1,189,977. Production of practice bombs. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-2546.

14—United Aircraft, East Hartford, Conn. $4,063,096. Production of modification kits for J-57 aircraft engines. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. N383-69000A.

—I. T. & T., Nutley, N.J. $8,608,897. Production of aerospace ground equipment for an airborne radio navigational system. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-67-C-0524.

—McDonnell Douglas Corp., Santa Monica, Calif. $1,000,000. Development, fabrication and testing of a Titan IIIC payload fairing subsystem. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0054.

15—Honeywell, Inc., Hopkins, Minn. $12,915,788 (contract modification). Manufacture of ordnance and associated equipment. St. Louis Park, Minn. Armament Development & Test Center, Eglin AFB, Fla. F33657-68-C-0372.

—F. D. Rich Co., Stamford, Conn. $3,840,000. Construction of a 200-unit family housing project at Grissom AFB, Ind. Grissom AFB, Ind. F12617-69-C-0101.

—Urban Systems Development Corp., Arlington, Va. $2,753,053. Construction of 150 family housing units at Andrews AFB, Md. Andrews AFB, Md. F49642—69-C-0184.

16—AVCO Corp., Wilmington, Mass. $2,600,000 (contract modification). Development and production of penetration aids. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-68-C-0021.

—McDonnell Douglas Corp., Tulsa, Okla. $1,810,000. Inspection, repair and maintenance of ten RB-66B aircraft. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F34601-68-A-3933.

17—Lockheed Aircraft, Marietta, Ga. $48,800,000. Procurement of the first 23 C-5A

airframes on Run B Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio F33 (657)-15053

—General Electric, Cincinnati, Ohio $68,-115,081 Production of 99 TF39 engines for C-5A aircraft. Evendale, Ohio Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio F33 (657)-15003.

—LTV, Inc., Greenville, Tex $3,102,281 Modification of C-130 aircraft. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-0707.

—General Electric, Cincinnati, Ohio. $1,-700,000. Production of support equipment for the T-64-GE-12 engine Evendale, Ohio Aeronautical Systems Div., (AFSC), Wright Patterson AFB, Ohio

—Fairchild Hiller Corp., Farmingdale, N.Y $5,496,000. Engineering and production of electronic counter measure equipment for F-105 aircraft Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif F04606-68-A-0003-0024

—General Dynamics, San Diego, Calif $3,-718,781. Launch support services at Vandenberg AFB, Calif Space & Missile Systems Organization, (AFSC), Los Angeles, Calif F04701-69-C-0052

—United Aircraft, East Hartford, Conn $3,-341,580 Production of manifolds and nozzles applicable to J-57 aircraft engines San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex N383-69000A

21—United Aircraft, Statford, Conn $2,145,-277. Production of replacement spare parts for various helicopters Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga F09603-69-A-0029-0090

—Bendix Corp., Ann Arbor, Mich $1,666,-908 Production of classified airborne communications equipment Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-1099.

—M.I.T., Cambridge, Mass. $1,000,000. Design and development of advanced instrumentation for missiles. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0162.

—Arojet General, Sacramento, Calif. $1,-547,000. Overhaul, modification and hot-fire testing of Titan II propulsion systems. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-0772.

22—Thiokol Corp., Bristol, Pa. $20,501,560 Production of Stage I Minuteman III motors for FY 1969. Brigham City, Utah Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-68-C-0173.

—Lear Siegler, Inc., Grand Rapids, Mich. $1,002,910. A/A24G-26A control assemblies for F-111 aircraft. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0662

—United Aircraft, East Hartford, Conn $3,-164,616. Production of case assemblies applicable to J57 aircraft engines San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex N383-69000A SA-69-850.

—Goodyear Aerospace Corp., Akron, Ohio $1,377,978. Production of air cargo handling pallets. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-69-C-1946-P001

23—Fairchild Hiller Corp., Farmingdale, N Y $11,219,117. Modification of the F105 flight control and navigation system, and for modification and flight testing of the F-105 weapons delivery system. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga F04606-68-C-1055 (P010 and P011).

—Air Logistics Corp., Pasadena, Calif. $1,198,948. 6,000-gallon capacity, aerial bulk fuel delivery system applicable to the C-130 aircraft. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex.

24—Raytheon Co., Bedford, Mass $1,456,339 Flight test of airborne radar equipment Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0379.

Hallicrafters Co., Rolling Meadows, Ill. $1,474,410. Production of components in support of airborne countermeasure transmitting systems. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F34601-68-A-2915

Applied Technology Co., Palo Alto, Calif. $2,626,000. Kits, spares, training aids and data for installation of 14-channel video tape recorder for F-105F aircraft. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-A-0141-0002.

General Electric Syracuse, N.Y. $5,200,-000 Test operations and related tasks in support of various Air Force programs Space and Missile Systems Organization, (AFSC), Los Angeles, Calif F04701-69-C-0050

27—Raytheon Co., Wayland, Mass $10,500,-000. Design, develop and test two prototype radar approach control systems North Dighton, Mass Electronic Systems Command, (AFSC), L. G Hanscom Field, Mass F19628-69-C-0091

—Hughes Aircraft, Fullerton, Calif $1,311,-322 Production of electronic components Electronic Systems Div., (AFSC), L G Hanscom Field, Mass F19628-69-C-0188

—Westinghouse Electric Co., Baltimore, Md $5,008,521 Production of spare parts for airborne radar equipment Ogden Air Materiel Area, (AFLC), Hill AFB, Utah F34601-69-A-0034.

—National Lead Co., Toledo, Ohio. $3,904,-426. Production of bomb components Batavia, N Y. and Toledo, Ohio Ogden Air Materiel Area, (AFLC), Hill AFB, Utah F42600-69-C-2753

—Honeywell, Inc., Hopkins, Minn $3,151,-329 Production of bomb components St Louis Park, Minn Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-2700

—Gibbs Die Casting Aluminum Corp., Henderson, Ky. $1,560,532. Production of BLU-26/B fragmentation bombs. Ogden Air Materiel Area, (AFSC), Hill AFB, Utah. F42600-69-C-2754

28—Watkins Johnson Co., Palo Alto, Calif $1,449,705 Production of directional finding equipment. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla F34601-68-C-4402.

—Superior Steel Ball Co., New Britain, Conn $1,410,000. Production of BLU 26 bomblet components. Washington, Ind Ogden Air Materiel Area, (AFLC), Hill AFB, Utah F42600-69-C-2751.

29—Brooks & Perkins, Detroit, Mich. $1,599,-242. Production of large cargo pallets. Cadillac, Mich. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09063-69-A-0029-0002AA.

31—General Electric, West Lynn, Mass. $5,-865,000. Production of CH-53D helicopter engines. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0005.

—Lockheed Aircraft Service Co., Jamaica, N Y. $4,088,107. Inspection, repair, and maintenance of C-121 aircraft. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F4606-69-C-0005.

Contract for F-14A Awarded by Navy

The Navy has awarded a $40 million contract to Grumman Aircraft Engineering Corp., Bethpage, N. Y., for the engineering development phase of its new supersonic, carrier-based fighter, the F-14A. The aircraft will have an all-weather capability for delivery of the Phoenix, Sparrow and Sidewinder missiles using the AN/AWG-9 weapons control system. It will also have an air-to-ground attack capability and a modern air-to-air high performance gun.

The contract provides an initial funding of $40 million for research and development of pre-production of the F-14. Funding under the development contract will total $388 million over a period of approximately four years. The contract also gives the Navy the option to procure up to 463 production models of the F-14, following the development phase.

Surface Effect Ship Contracts Awarded

Contracts have been awarded to Aeroject-General Corp., El Monte, Calif., and Bell Aerosystems Co., Buffalo, N. Y., for research and development work on a 100-ton surface effect ship (SES) testcraft.

The contracts were awarded by the Maritime Administration of the Department of Commerce in a joint effort with the Navy to determine the feasibility of building and operating large, high-speed surface effect ships of 4,000 to 5,000 tons. Purpose of the program is to develop a testcraft which can provide vital information on alternate design configurations, structural, lift, propulsion and flexible seal systems in actual sea conditions.

Both contracts are cost plus incentive fee awards which will be incrementally funded. Current fiscal year funding for each contractor is $1.55 million, and will cover detailed engineering design. The contracts will be managed by the Join Surface Effect Ships Program Office which reports to both the Navy and the Commerce Department.

Army Awards TOW Production Contract

The Army has awarded a $55,371,527 contract to Hughes Aircraft Co. for production of the TOW (Tube-launched, Optically-tracked, Wire-guided) antitank assault missile system.

Under the contract, missiles will be manufactured by the Hughes facility at Tucson, Ariz. Launchers and ancillary equipment will be produced at sites in the Los Angeles, Calif., area.

The TOW system, capable of stopping all known types of armored vehicles, is controlled by two hair-thin wires that unreel after the weapon is fired and provide steering signals. The TOW missile is automatically guided to point of impact by keeping the sight on the target.

TOW is expected to replace the 106mm recoilless rifle as well as the Entac and SS-11 missiles. Project Manager for the system is Lieutenant Colonel Robert W. Huntzinger, U.S. Army Missile Command, Redstone Arsenal, Ala.

ɿw Defense Team

etary of Defense

ʼIN R. LAIRD became Secretary of Defense on .2, 1969. He was administered the oath of office White House ceremony, together with other :abinet members. When nominated, Secretary represented the Seventh District of Wisconsin U. S. House of Representatives, where he had l continuously since 1952. Before becoming a er of the U. S. Congress, he served in the Wis- ı State Senate from 1946 to 1952. His major ·sts and committee work in Congress were in reas of national security, education and health. rved on the House Appropriations Committee, · Committee on Agriculture, and various sub- ittees including Defense; Labor; Health, tion and Welfare; and Military Construction. g World War II, Secretary Laird served in the Navy from 1942 to 1946. Mr. Laird was born ɜpt. 1, 1922, in Omaha, Neb., and his family l to Wisconsin the following year. He attended Aarshfield, Wis., public schools, and received achelor of Arts degree from Carleton College, field, Minn., in 1944.

Deputy Secretary of Defense

DAVID PACKARD was administered the oath of office of Deputy Secretary of Defense at a Pentagon ceremony on Jan. 24, 1969. Prior to assuming his new position, Secretary Packard was Chairman of the Board and Chief Executive Officer of the Hewlett-Packard Co., Palo Alto, Calif. The company was formed by Mr. Packard in partnership with William R. Hewlett in 1939 to design and manufacture electronics measurement instrumentation. The firm was incorporated in 1947 and has become an international organization engaged in design and manufacture of electronic, biomedical and analytical equipment. Mr. Packard was born in Pueblo, Colo., on Sept. 7, 1912, and attended public schools there. He entered Stanford University in 1930 and was graduated from that university with a Bachelor of Arts degree in 1934. He later returned to Stanford University where he received a degree in electrical engineering in 1939. In addition to his position with the Hewlett-Packard Co., Mr. Packard has also served as a director of several business organizations.

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ʼLEY R. RESOR, who has served cretary of the Army since 1965, een reappointed to the position. e assuming this position, Secre- Resor was a partner in the New City law firm of Debevoise, ton, Lyons and Gates, specializ- ı corporate law. Secretary Resor ɔorn in New York City on Dec. 5, He is a graduate of Groton l, Yale University, and the Yale School. He interrupted his law ɜs to serve with the Army during l War II from 1942 to 1946. Re- ıg to inactive status, he returned ıle Law School and received a ɔlor of Law degree in June 1946.

Navy

JOHN H. CHAFEE assumed the position of Secretary of the Navy on Jan. 31, 1969. He was elected the Governor of Rhode Island in 1962, and re-elected to that office in 1964 and 1966. Prior to the governorship, he served as a member of the House of Representatives of the Rhode Island General Assembly for three terms. Secretary Chafee was born in Providence, R. I., on Oct. 22, 1922. He is a graduate of Yale University and the Harvard Law School. He served in the U. S. Marine Corps from 1942 to 1945. With the outbreak of the Korean War, he was recalled to active duty in 1951 and served in Korea until June 1953.

Air Force

ROBERT C. SEAMANS JR. became Secretary of the Air Force on Feb. 15, 1969. When appointed, he was the Jerome Clarke Hunsaker Professor, a Massachusetts Institute of Technology endowed visiting professorship in the Department of Aeronautics and Astronautics. From 1960 to 1968, he served in the National Aeronautics and Astronautics Administration, first as Associate and later as Deputy Administrator. Secretary Seamans was born in Salem, Mass., on Oct. 30, 1918. He holds a B. S. degree in engineering from Harvard University, and an M. S. degree in aeronautics and a doctorate in instrumentation from the Massachusetts Institute of Technology.

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Suggestions from industry representatives concerning possible topics for future issues are welcomed and should be forwarded to the Editor at the address shown below.

The *Bulletin* is distributed free of charge to qualified representatives of industry and of the Departments of Defense, Army, Navy, and Air Force. Subscription requests should be submitted on company letterhead stationery, must indicate the position title of the requestor and be addressed to the Editor, Defense Industry Bulletin, OASD (PA), Pentagon, Washington, D. C. 20301.

IN THIS ISSUE

FEATURES

DEPARTMENTS

End product of support re dered by Naval Material Co mand is epitomized by ships and aircraft of Na Task Force Alpha, featured the cover. The story of Naval Material Command gins on page 1.

ral Material Command—
m of Systems

Admiral I. J. Galantin, USN

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an inclusive term that blankets the whole material cycle (for example, it includes shipboard maintenance), is vested solely in the Naval Material Command. The operating commands of the Navy, the shore commands, and the Marine Corps all perform some aspects of material support, but incidental to their main mission. For the Naval Material Command, it *is* the mission.

The organization of the Department of the Navy is by no means simple; it is complicated by its hugeness but even more by the variety of its military functions and by its unique combination of two military services, the Navy and Marine Corps. Even the Washington veteran can lose his way in the official charts. The Chief of Naval Material is an "echelon 2" commander, *i.e.*, a direct subordinate of the Chief of Naval Operations (CNO).

Historical Development

The genealogy of the headquarters element of today's Naval Material Command, formed in 1966, can readily be traced back through the "new" Office of Naval Material (organized in 1963), the "old" Office of Naval Material (1948), the Material Division in the Office of the Secretary of the Navy (1946), the Office of Procurement and Material (1942), and the Material Division in the office of the CNO (1941). Much more ancient is the lineage of the subordinate systems commands, which as bureaus or parts of bureaus go back at least to 1842.

It has long been recognized that coordination among the "hardware" and logistic support elements of the Navy is necessary. Historically, various means have been employed. The Secretary of the Navy himself, with the help of his assistants, has in times past performed this function. The Chief of Naval Operations had certain coordinating responsibilities. In his earlier role, the Chief of Naval Material coordinated Navy bureaus in procurement, production and supply matters, acting in a "staff" capacity at the secretarial level. Finally, the former bureaus under various mechanisms and agreements cooperated with one another in mutual enterprises.

These means were successful to some degree, but the Navy decided that more was needed. In the stress of World War II, a special and powerful wartime agency (the Office

Admiral I. J. Galantin is Chief of Naval Material, Naval Material Command. He has served in various command positions. He was Director of Antisubmarine/Submarine Warfare Division in the Office of Chief of Naval Operations, and Special Projects Officer in the Office of the Secretary of the Navy, before assuming his present position.

of Procurement and Material, mentioned earlier), headed by a vice admiral was formed to supervise some aspects of the Navy's production efforts, and to deal centrally with the War Production Board and like agencies. This wartime office declined after the war, but as the complexity and cost of naval warfare systems burgeoned in post-war years, the need for stronger direction and coordination of material efforts again made itself evident, even in peacetime.

Along with other factors, this growing conviction that a "management gap" existed in the Navy led to a massive study in 1962 at the direction of the Secretary of the Navy. The resulting "Dillon Report" recommended " . . . that the Secretary of the Navy establish under his immediate supervision a Chief of Naval Support to coordinate, control, direct, and command the Chiefs of the Bureaus of Naval Weapons, Ships, Supplies and Accounts, and Yards and Docks."

This the Secretary did, but with no change. Instead of setting up a wholly new Chief of Naval Support, he decided to use the resources at hand. He vested the new command function in the Chief of Naval Material (who would continue to exercise his previous staff functions). Thus in December 1963, the Naval Material Support Establishment (NMSE) was formed, comprising the "old" Office of Naval Material, and the four material bureaus along with their field activities. The NMSE incorporated also the three project management offices that had been established earlier by the Secretary: Special Projects (Polaris), F111B/Phoenix, and Surface Missile Systems (the three Ts—Terrier, Tartar, and Talos).

The latest step in the evolution of the Naval Material Command occurred two and a half years later. In 1966, after careful analysis by the Chief of Naval Operations and the Commandant of the Marine Corps, the Secretary directed two changes in Navy organization. First, NMSE was to be restructured and renamed the Naval Material Command (NMC); second, three supporting commands (Bureau of Naval Personnel, Bureau of Medicine and Surgery, and the new Naval Material Command) were to be placed under the Chief of Naval Operations.

To form NMC, the basic structural change was to convert the four material bureaus into six systems commands. Essentially, the Ship Systems and Electronics Systems Commands now conform to the old Bureau of Ships; the Air Systems and Ordnance Systems Commands conform to the old Bureau of Naval Weapons. The other two systems commands, Supply Systems and Facilities Engineering, correspond closely to their predecessors, the Bureau of Supplies and Accounts and the Bureau of Yards and Docks.

Operating Concepts

The Naval Material Command consists essentially of four elements: headquarters, systems commands, project management offices, and directly-commanded shore activities (see Figure 1). The chart, of course, can show only the visible form of organization and not its essence, the division of responsibilities and the mutual relationships.

The systems commands constitute by far the largest of the four organizational elements. Together, they account for nearly 90 percent of the 300,000 personnel in NMC. The systems commanders are the principal line executives of NMC. They develop, design and procure naval systems and equipment, ranging in size from the carrier Nimitz to the handheld radio. It is they who let most of the contracts, administer most of the appropriated funds, and control most of the supporting shore activities.

Because all the systems command headquarters are located in Washington, most in the same building with the Chief of Naval Material and his staff, the Naval Material Command is sometimes thought to be highly centralized. This proximity is convenient, but misleading; NMC in fact is and must be a decentralized organization, similar in many respects to a large, multi-product corporation. The headquarters corresponds to the "corporate level," the systems commands to operating divisions, and the laboratories and other independent activities to corporate-level supporting functions and common services. Even the project managers have their counterparts in industry, where special groups are formed to fulfill (or pursue) large contracts.

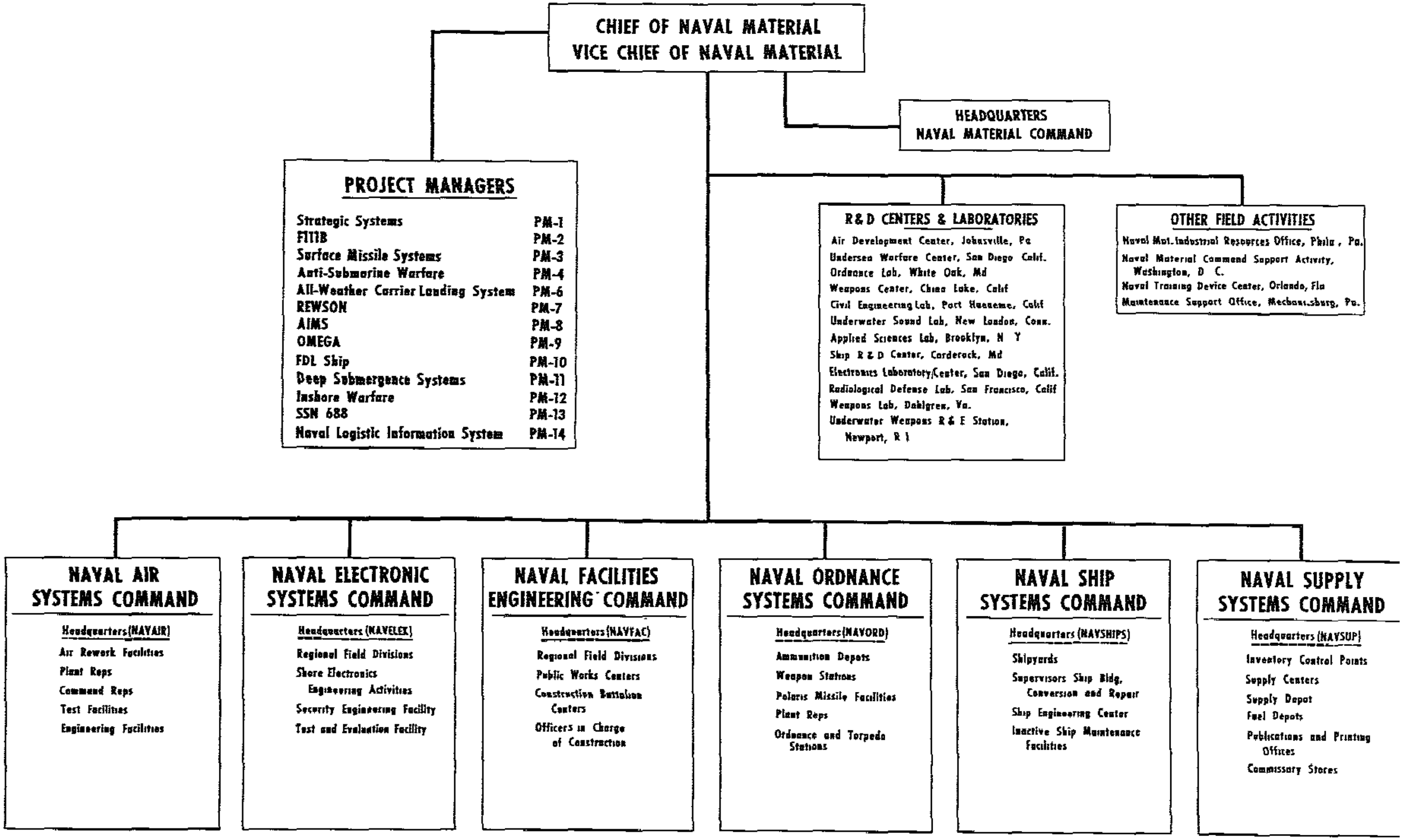
The headquarters of NMC, with about 600 people, is by design quite small. It concentrates on the normal staff functions, serving as an "extension of the commander" by assisting him directly in the overall management of the command: in planning and basic policy making, in organizing, in assigning work and allocating resources, in coordinating where needed, in following progress and evaluating performance. It "gets into operations" only as necessary for central control in such supporting programs as management information systems and research, development, test and evaluation management. Early in 1966, the Chief of Naval Material issued these guidelines for the headquarters staff:

> **We must be aware of problems and give help where needed. We need information, but not in the detail needed by project managers and Systems Commanders. We have to stick to essentials. We are not big enough to get into details. I don't want us to be guilty of holding onto work that belongs to the project managers and the Systems Commanders. We must not usurp their job. But we expect them to keep us posted. Our job is not to do, but to manage.**

By means of "charters" for the systems commands and for the "CNM-designated Project Managers" (those project managers who report directly to Chief of Naval Material), and by amplifying directives in various program areas, the Chief of Naval Material tries to define as clearly as possible the "management packages" to be achieved by each of his line executives. Insofar as possible, these packages are defined in terms of "systems" in the hardware sense. The process, it must be admitted, is inexact. Men of good will often disagree on where a given system begins and ends, and on what is vital to system integrity.

Actually, any system is only part of a larger system which, in turn, is part of a still larger system. A fire control system is part of a weapon system is part of a ship system is part of an air defense system is part of an amphibious warfare system

NAVAL MATERIAL COMMAND



and so on. Within the Navy, NMC is but one of several commands, many of which are engaged in "material" functions. Within NMC, individual system managers look after individual warfare systems, but they all affect one another. The command must operate as a coherent whole; in effect, it must be a "system of systems."

Another complication in defining clear work packages and clear interfaces is the need for "horizontal" emphases or constraints. If we consider system or project management to be the "vertical" dimension of organization (and it is in NMC), the horizontal dimension includes such disciplines as configuration control and value engineering, which apply equally to all systems and projects. It also includes across-the-board service functions, such as supply support, facility construction, and training devices, which for reasons of efficiency and standardization (and sometimes by direction of higher authority) are centrally managed.

Still another horizontal aspect of NMC organization is the research, exploratory development, and systems development that is performed by the laboratories and centers. These research and development activities, with more than 25,000 personnel, report directly to the Chief of Naval Material. They are oriented toward specific warfare and technology areas. This orientation differs from the "end-product" ship, aircraft, ordnance, and electronics orientation of the systems commands; therefore, the work of a given laboratory often supports the overall systems responsibilties of two or more systems commands. For this and other reasons, the management of NMC laboratories was centralized, about three years ago, under the new position of Director of Laboratory Programs in NMC headquarters.

Much of the inter-systems command coordination has been assigned to the systems commands themselves, rather than to the NMC headquarters staff. The reasons for this are:

• To keep functions at the lowest feasible level and, thus, restrain the upward migration (and consequent ballooning of headquarters) that so often occurs in large organizations.

• To promote an atmosphere of mutual awareness and cooperation among NMC components so that only the most serious systems problems require the attention of the Chief of Naval Material and his staff.

In line with this policy, the Naval Ship Systems Command exercises "ship life-cycle management" coordination responsibilty, in which the many shipboard systems are blended into an effective whole, both in their original design and in their acquisition and operational support. For aircraft, the Naval Air Systems Command performs a similar function; and for multi-platform electronic systems, it is the Naval Electronic Systems Command.

In addition to these special coordination assignments, the planning disciplines that are required of systems managers also work to improve cohesion of effort, both within NMC and between it and other commands. The manager develops several component plans, which collectively form overall systems management plans, for technical development, funding, procurement, and integrated logistic support. The integrated logistic support plan comprises several subplans—for provisioning and supply support, for facility support, for personnel and training support, for

SYSTEMS COMMANDS OF THE NAVAL MATERIAL COMMAND

MAJOR PROGRAMS AND FUNCTIONS

NAVAL SHIP SYSTEMS COMMAND	NAVAL AIR SYSTEMS COMMAND	NAVAL ORDNANCE SYSTEMS COMMAND	NAVAL ELECTRONIC SYSTEMS COMMAND	NAVAL FACILITIES ENGINEERING COMMAND	NAVAL SUPPLY SYSTEMS COMMAND
• SHIPS & CRAFT: ACQUISITION, CONVERSION, MODERNIZATION, OVERHAUL	• AIRCRAFT: ACQUISITION, MODERNIZATION, OVERHAUL	• SHIPBOARD WEAPON SYSTEMS: ACQUISITION, MODERNIZATION, OVERHAUL	• COMMUNICATIONS SYSTEMS: SHIP, SHORE, SATELLITE	• MILITARY CONSTRUCTION	• SUPPLY MGMT.
• SHIP SYSTEM INTEGRATION & LIFE-CYCLE MGMT	• AIRCRAFT EQUIPT.	• ORDNANCE SYSTEM INTEGRATION	• FIXED SURVEILLANCE SYSTEMS	• REAL PROPERTY ACQUISITION, DISPOSAL, INVENTORY MGMT.	• PRINTING & PUBLICATIONS
• SHIP EQUIPMENT: HULL, MACHINERY, ELECTRICAL, OTHERS	• AIRCRAFT SYSTEM INTEGRATION	• MINES, TORPEDOES, GUN AMMUNITION, SHIP LAUNCHED MISSILES: ACQUISITION, STORAGE, LOADING, ASSEMBLY, ETC.	• NAVIGATION AIDS, AIR TRAFFIC CONTROL EQUIPT.	• NAVY HOUSING MANAGEMENT	• EXCHANGES, COMMISSARIES, SHIP STORES, FOOD SERVICE
• SALVAGE & DIVING	• AIR LAUNCHED WEAPONS & EXPENDABLES	• EXPLOSIVES: TECHNOLOGY, SAFETY, DISPOSAL	• COMMAND CONTROL SYSTEMS	• FACILITY PLANNING, & PROGRAMMING	• FIELD PURCHASING MANAGEMENT
• SONARS & SURVEILLANCE RADARS	• SHIPBOARD CATAPULTES, ARRESTING GEAR, VISUAL LANDING AIDS	• SMALL ARMS, SWIMMER WEAPONS, DEMOLITION CHARGES, ETC.	• GENERAL TEST & TELEMETRY EQUIPMENT	• FACILITY MAINTENANCE GUIDANCE	• TRANSPORTATION MANAGEMENT
• INACTIVE (RESERVE FLEET) SHIP MANAGEMENT	• PHOTOGRAPHIC EQUIPT. & TECHNOLOGY		• ELECTRONIC WARFARE EQUIPMENT, SHIP, SHORE	• NUCLEAR SHORE POWER	• MOVEMENT OF HOUSEHOLD GOODS
	• METEOROLOGIC EQUIPT. & TECHNOLOGY		• ELECTRONIC TECHNOLOGY, COMPATIBILITY, ETC.	• AUTOMOTIVE, RAILWAY, CONSTRUCTION, WEIGHT-HANDLING, EQUIPMENT	• MATERIAL HANDLING, FOOD SERVICE EQUIPMENT
				• NATURAL RESOURCES	• NAVY STOCK FUND MGMT.
				• POLLUTION CONTROL	
				• NAVY SEABEE SUPPORT	

HEADQUARTERS NAVAL MATERIAL COMMAND

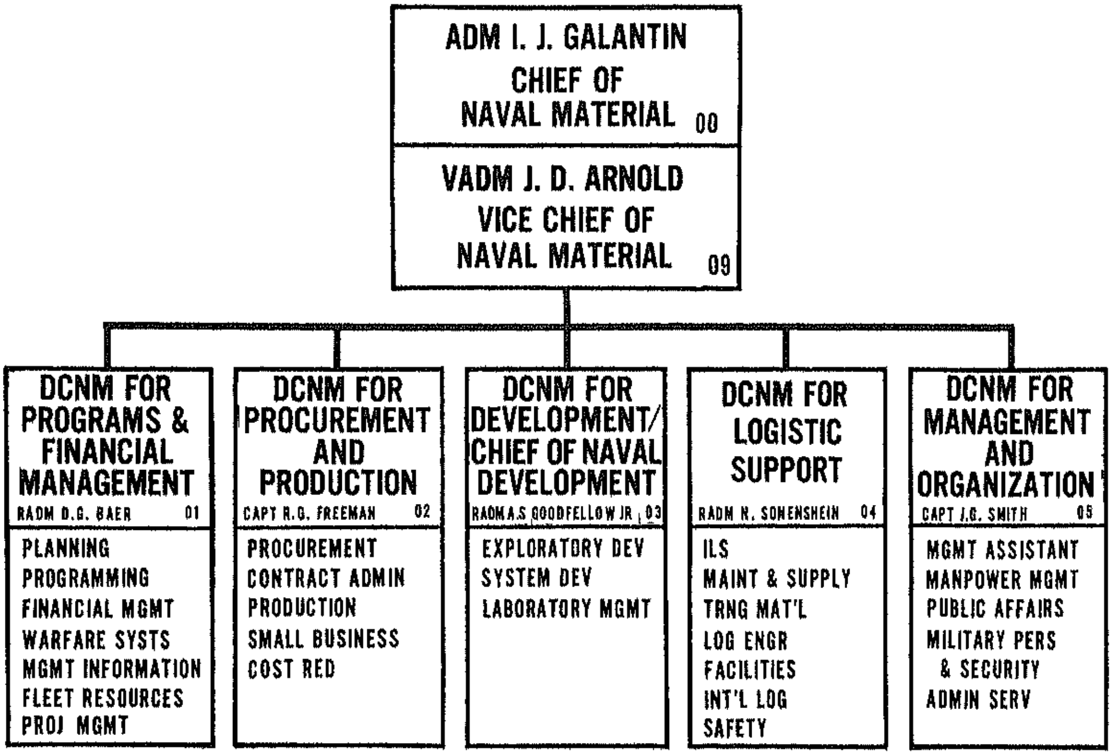


Figure 3.

nstallation in operating units, etc. An important duty of the NMC ıeadquarters staff (and one not calculated to win popularity awards) is the policing of these planning disciplines— trying to see that they are done right and done at the right time.

lajor Programs—Size and Scope

The programs carried on by NMC are notable not only for their size but also for their variety, which reflects the variety and scope of the Navy-Marine Corps missions in national defense. Undersea, surface, carrier strike, strategic missile, amphibious, electromagnetic, inshore and riverine and land, antisubmarine and nti-air—all these warfare capabilities are supported by systems and equipment, and by logistic and industrial operations ashore.

The annual NMC procurement programs now approximate $10 billion, in a total NMC budget of about $13.5 billion. The 300,000 NMC personnel, about 8 percent military and 2 percent civilian, are located in bout 320 field and headquarters activities, more than 95 percent outside of Washington. The largest single user of NMC manpower is the shipyard complex, with about 100,000 personnel.

Because the operations of each of the six Naval systems commands will later be described in the *Bulletin*, only a brief summary is provided here (see Figure 2). For brevity, many of the lesser programs are not shown. A good description of the Naval systems commands, as well as that of other DOD agencies, can be found in the "U. S. Government Organization Manual," updated annually and available from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402, for $2.

Management Concepts and Trends

Much of the 600-man staff at Headquarters, Naval Material Command, devotes its attention to broad command policy and procedures —ground rules for the operation of the entire command. These matters often impact directly on Navy contractors and brief mention of some of them follows.

The concepts and trends that are emerging in Navy management of development, acquisition, and logistic support do not all originate in one place, of course, nor do they burst full-blown on the management scene. Ordinarily they evolve gradually, based on experience (good or bad)—often with the helpful advice of industry. Sometimes new laws, or evidence of Congressional interest, speeds their evolution. The Office of the Secretary of Defense, as well as the Secretary of the Navy, encourage and sometimes prescribe new methods and policies.

Of the five deputies on the Chief of Naval Material's staff (see Figure 3), the one most involved in matters of direct concern to industry is probably the Deputy Chief of Naval Material (Procurement and Production). His directorate (MAT–02) serves a dual purpose. It assists the Assistant Secretary of the Navy (Installation & Logistics) in the policy areas of procurement, contract administration, contract costs, contractor performance evaluation, and the like, for application to the Department of the Navy as a whole. At the same time, MAT–02 broadly supervises the

procurement/contracting function, and the related functions of production reporting and management control systems, within NMC.

At the Chief of Naval Material management information center recently, the Deputy for Procurement and Production outlined his goals for the forthcoming year. Without neglecting the continuing efforts such as cost reduction, small business, and labor relations, he plans to work in particular for improvement in several broad areas.

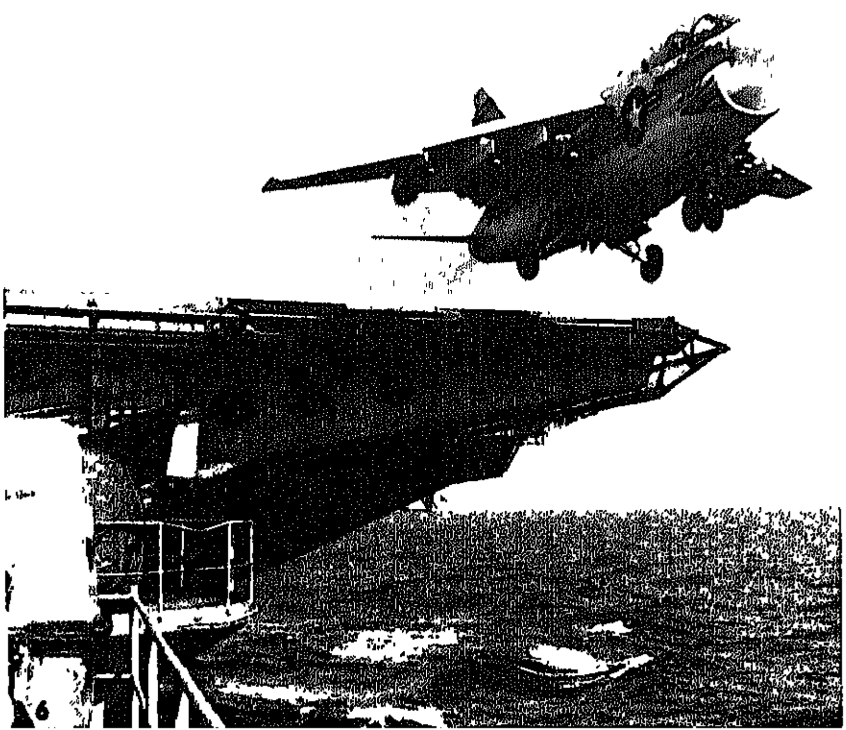
One such area is selecting the proper form of contract for a given acquisition. Each acquisition has its own character, its own risks. The contractual instrument must correspond to this character and these risks. The fixed-price contract, for example, may not be the best instrument if an acquisition entails significant development effort. More skill and more judgment must be applied in the choice of contracting method. To this end, procurement personnel now play a more active role in the earlier stages of system development, working side by side with engineers and logisticians.

Another challenge to be met is to improve the procedures by which items developed by Navy laboratories are transferred to industry for production. A successful prototype at the laboratory does not necessarily assure a successful production model. Where the contractor has assisted the laboratory during development, the Navy may support initial volume production by that contractor, in which case the Navy will try to ensure that this contractor produces a usable data package, to allow reprocurement from another production source with no more than reasonable engineering effort by the second source.

As to competition, the Navy wants competitive bids whenever it is practical and reasonable to seek competition. There is no useful purpose, however, in encouraging a number of companies to prepare proposals if it is known that only one source can do the job. If competition is impractical, the fact must be recognized and both industry and the Navy spared the time and expense of competitive bids.

Finally, contract administration deserves special attention. Some of the toughest procurement problems surface after the contract is awarded and work begun. These problems must be resolved promptly and intelligently. Contract administration is a demanding business, and it warrants capable, experienced Navy personnel in our contractors' plants. Headquarters, Naval Material Command, will emphasize this need, and work with the systems command and the Defense Contract Administration Service to improve their contract administration networks and to streamline their operations.

Carrier USS Ranger (CVA-61) shown launching A-7 Corsair aircraft on attack mission.



Logistic Disciplines

One of the most difficult challenges in major system management is to help keep them "on the line" after they are in the hands of the Fleet. NMC constantly works to improve, both afloat and ashore, the day-to-day management of maintenance and supply—the most visible aspects of logistic support. Much has been achieved to aid the 20-year-old sailor in maintaining his piece of equipment through better allowance lists of spare parts, better guidance and training on "how to fix it," and quicker action on his requisitions.

The Deputy Chief of Naval Material (Logistics Support) heads up the "logistic family" in the NMC. His directorate (MAT-04) polices and spurs improvement in supply and maintenance operations for material already in the Fleet. Recognizing, however, that steps to attack one of the root causes of today's logistic problems, *i.e.*, the growing complexity and variety of systems, equipments, and components, must be pursued along with attacks on today's problems, the MAT-04 group guides and prods the systems commands in several "logistic disciplines." These

disciplines or special programs share one basic objective: to reduce the eventual supply and maintenance burden of Navy forces.

Though some of these disciplines get extraordinarily complex in their planning and execution, they are relatively simple to describe in terms of their objectives. Several examples are presented here, chosen for their immediate interest to Navy contractors.

Standardization, and the closely-related program of "item entry control," are aimed at making our ships, airplanes, and major systems "look more alike," not just in silhouette but in detail—down to feed pumps, electrical fittings, and life jackets. An analysis two years ago showed that, of the 180,000 or so different hull, mechanical, and electrical equipments installed in 900 active ships, 57,000 were installed in *only one ship*, and many others in only two or three ships. It is easy to imagine the logistic complexity that results from this, the proliferation of spare parts, technical data, maintenance instructions, and training requirements.

Progress is painfully slow. The present inventory must be "worked down" through new construction and alteration; we cannot just heave overboard the non-standard items. Discipline at the source is the only practical approach. Among the steps being encouraged are specifications requiring identicality in multi-year procurements, standardization incentive clauses in contracts, and standard component lists.

Coupled with these individual steps is an extensive configuration management program. A three-phase process, configuration management requires, first, that the "baseline" or standard configuration be identified and documented in specific functional and engineering terms; second, that any proposed changes to this baseline be rigidly evaluated for worth versus cost (not just immediate cost but life-cycle cost as well), and that change decisions be approved at a level high enough in the organization to restrain the engineer's tinkering syndrome; and, finally, that approved changes be reflected promptly in a "product" baseline and in maintenance directives, spare parts allowances, etc.

Still other methods of "discipline at the source" are being pursued: Zero Defects, a program to encourage quality in manufacture ("do it right the first time"); and maintenance feedback, by means of automated information systems (the 3-Ms), which alert the design engineers and logistic planners, both Navy and contractor, to maintenance problems in present systems so that they may "do better next time." Increased emphasis is being given to test and demonstration to assure the meeting of quality, reliability, and maintainability requirements in contracts. Other special efforts could be cited—value engineering, for example, and specification improvement—all aimed in part at improving the original product in order to lessen future support problems.

In other ways, contractors more and more will find themselves concerned with follow-on support of systems and equipment. Life-cycle cost considerations enter into increasing numbers of management decisions, especially in systems undergoing concept formulation and contract definition. The integrated logistic support (ILS) discipline injects support considerations, such as provisioning, technical manuals, and training needs, into the early design and acquisition stages. Contractors will be expected to deliver systems that the Navy—and the 20-year-old sailor—can live with.

Development Planning

Another trend in Navy system management is the increasing involvement of research and development centers and laboratories in the advanced stages of system development. In the overall effort to broaden the "life-cycle" awareness of laboratories, these activities are receiving assignments for system analysis, system engineering and integration, and related efforts such as technical direction of acquisition contracts. Overall system acquisition and support responsibility remains, of course, in the systems commands, but the laboratories are becoming active participants. This shift of emphasis is only relative; laboratories are still heavily engaged in the more basic areas of research and technology.

The Deputy Chief of Naval Material for Development (MAT 03) seeks in several ways to improve communications between the Navy research and development community and industry. Plans are underway to establish, in headquarters, the NARDIC (Naval Research and Development Information Center). Its purpose is to provide a clearinghouse for information to industry on the Navy's research and development plans and problems, in the hope of obtaining more timely and better input from industry in solving the problems and carrying out the plans. Three publications are available now, upon request (write to Headquarters, Naval Material Command, Washington D.C. 20360): "Navy and Marine Corps R&D Problems," "Naval Research Requirements," and "Naval Research Opportunities." To be added as NARDIC becomes fully operational are basic "requirements" documents (General Operational Requirements, Specific Operational Requirements, Advanced Development Objectives) and certain progress reports.

The Deputy for Development, in support of an overall DOD effort, provides "research development, test and evaluation program input" for Advanced Planning Briefings for Industry (APBI). These briefings, sponsored jointly by various industry and DOD organizations, occur about four times a year. They are designed to inform industry on the long-range outlook on required military postures, and on technological advances needed to support future needs. More than 700 industry technical representatives attended the latest APBI, held at Coronado, Calif., in January. The theme of the meeting was "Amphibious, Inshore, and Special Warfare." It was sponsored by the Electronic Industries Association, the National Security Industrial Association, and the Navy. Announcements on APBI appear in the *Defense Industry Bulletin* as well as trade and association journals.

The Defense Management Environment

This discussion of the Naval Material Command—its work, its evolution, its structure, its programs, and some of its concepts—can only touch on the total affairs of the command. In subsequent issues, the systems command will tell their individual stories, in more detail no doubt.

A word in closing on the unusual management environment that has prevailed for the past several years might be in order. The Naval Material Command, like the rest of the Defense Department, operates in the "twilight zone"—half war, half peace. On the one hand, the demands of

(*Continued on inside back cover*)

Quality Control Is Known in Its Absence

RAdm. A. R. Gralla, USN

Address by RAdm. A. R. Gralla, USN, Commander, Naval Ordnance Systems Command, at the 12th Annual American Society for Quality Control and California State Polytechnic College Quality Control Conference, Pomona, Calif., Jan. 25, 1969.

Quality is known by the company it keeps, or more properly, "A company is known by the quality it keeps."

To discuss quality control, I'd like to give my thoughts on quality control as I see it through the eyes of a major producer and purchaser of military equipment, and to break the subject down into its elements—quality and the control of quality, with special emphasis on the military aspects of both.

Because I am an engineer, like most of you here, I wanted to be sure of my terms before going into any discussions. Unfortunately, I found that definitions in the dictionary leave something to be desired, even in unabridged versions.

Quality denotes (in our sense) a degree of excellence, a measure of aristocracy—in brief, something over and above the ordinary.

Control (in our sense) must mean our ability to provide over a complete range of conditions a "repeatability" of product quality, of the highest order and, naturally, at a reasonable price. (Note I said reasonable price and not lowest price, because all too often high quality and low cost do not go hand in hand, and quality is sacrificed to cost.)

It is an anomaly, but quality control is more apparent in its absence, rather than in its presence. This arises because quality control is associated with production, the assumption being that the research and development phase has evolved a fully producible design, and repeatability of that design is then the problem of the quality control organization.

The woods are full of examples of poor quality control, and while the failure of quality control becomes catastrophic, success receives a mere shrug of the shoulder. Let me expand a bit on what occurs. Blamed on poor quality control (rightly or wrongly), and after a proper design has been demonstrated, are the following sins of omission, manifested as additional production costs and the loss of profits:

- Low reliability and, hence, high failure rate in service.
- Difficulty of repeatability or producibility.
- Delays in volume production.
- Difficulty in fluid maintenance, upkeep and adjustment.
- High cost in production and throughout the life cycle of the system.
- Lack of confidence in the system and the people who produced it (tarnished reputation), and a subsequent failure to obtain further contracts (attributed to the corporate memory of the customer).

What Are the Causes? Where Do We Attack It?

Quality must be bred into horses, and used to be considered an attribute of good breeding in men. Since most of our hardware is the product of men's minds and not by transmittal of their genes, the breeding process must give way to the computer and the drafting board. Actually, quality must be designed into a piece of hardware if it is ever to be achieved.

There is a relationship to the Zero Defects Program, although I have found that Zero Defects is commonly, falsely equated with quality control. I prefer to think of the Zero Defects Program as only a subsidiary part of the overall quality control task, and related to personal attention given to the "reproducibility" of the production process.

Again resorting to definitions, I find that the Zero Defects Program is defined as:

A motivational approach to the elimination of defects attributable to human error—a voluntary program aimed at improving the quality and reducing the cost of producing and maintaining defense material—an organized effort to inspire personnel at all levels in an organization to do their job right the first time, every time.

In military planning we test an operations plan for logistic feasibility. How many of your companies call you in to check their design for quality "controlability?" I should like to see quality control started before the fact and not after.

Organization for Quality Control

The quality control function must be objective. Like the "inspector," it must be responsive to top management—the eyes, ears and nose of the corporate top level management. Too often I have found quality control submerged in production, tied by an umbilical to engineering, a camp follower of the research and development organization, a partner of value engineering, or just a plain "Little Orphan Annie" of the corporate house.

So without "preaching to the choir" in this audience of quality control engineers, I would like to advocate a position of quality control as a separate department—such as I have done in our own ordnance production facilities. However, please remember that my task here today is to relate you and to you, the impact of quality control. Thus in my remarks I have only the "why," while to you remains the "how" of the problem. Hopefully, today's meeting will make that the easier to attain.

Profits vs Penalties

Until now I have alluded to the penalties of poor quality control; now let us get on to the positive side of the coin.

Doing it right the first time is related to preparation in engineering, design and production to assure the repeatability of the process or product. There must be the assurance that each article is exactly like its predecessor. This assurance comes with testing (and its partner, metrology), in all environments and conditions.

For example, one of our torpedoes had a nose problem. We were unable to duplicate a nose after we had designed and manufactured a good one. There were many reasons for the impasse—poor documentation, poor process control (application of epoxy, determining the proper number of holes in the good retaining ring)—in short, poor quality control.

An example involving another torpedo was its failure to pass in-water tests after having satisfactorily passed the prescribed factory tests. Here, poorly designed testing procedures and a failure to recognize environmental factors were responsible for expensive re-working. Again, quality control becomes involved.

So you can see that I hold quality control responsible for more than blind testing. I expect the quality control people to become tools of management—to recognize shortcoming, exert initiative—in a sense to be creative in the interest of arriving at a better product.

What does this mean? In terms of corporate profits, it is truly a matter of sink or swim. It is also a matter of life or death, because in ordnance we play with explosives which can just as easily kill or maim our friends as our enemies.

An example was the MK 45 primer for the 5-inch/54-caliber gun cartridge case. An eccentric screw-thread machine was permitting some primers to be assembled with a gap where torquing pressures would be reached without the parts going all the way home. A simple defect, yes, but failure to meet specification caused three accidents, many thousands of dollars of loss, and serious injury to a dozen men.

In each of these cases the company involved lost money and reputation. Reputation is important because it gives us the confidence to contract further with the company, and not look afield—in other words, the creation of the satisfied customer psychology.

For example, we were about to go to a particular torpedo contractor for additional torpedoes of a type he had produced in the past but, because of his quality problems in another product line, doubt was cast on his ability to produce the product he had done so well on in the past. I suppose this is much like the typical Congressional constituent who says, "Yes, I know you did me a lot of favors in the past, but what have you done for me recently?"

Company Reputation on the Firing Line

Ultimately, of course, a company's reputation for quality extends to the serviceman on the line. The one upon whom is thrust the full impact of quality control, or the absence of it, is the sailor on board ship or the marine or soldier in the jungles, rice paddies and trenches. A company's name is clearly marked on the weapons and equipment he uses, and this gives him an urgent sense of knowledge and familiarity with that name. The identity is especially vivid under conditions of combat, for in the final reckoning a company, products, and its reputation a etched in the memory of that ser iceman each time his weapon p forms well, or each time his weap fails to perform. In the last anal sis this is really the essence quality control—the ability to me the acid test of battle, where on quality pays off—be it in men hardware.

Yours is the challenge to get t quality into the hands of the ult mate user. The challenge is a re one. The rewards, aside from t sense of doing a job well, come the corporate profits of the succes ful producer. So quality control e tends to the profit motive as well the patriotic one. A good product only as good as the quality it kee —and that is yours to control.

Navy To Charter Nine New Tankers

The U.S. Navy's Military S Transportation Service (MSTS) h entered into a charter-build agre ment with the Central Gulf Stean ship Co., New Orleans, La., for tankers to replace 16 T-2 tanke of the MSTS fleet. Requests for pr posal for this ship construction we issued to the maritime industry July 1968. The new tankers are e pected to be in service with MST within three years.

The ships will be built for Centr Gulf by the Bethlehem Steel Co. shi yard at Sparrows Point, Baltimor Md., at a cost to Central Gulf $115 million. The ships will th be chartered to the Navy on a "bar boat" basis, *i.e.*, without crew, f a period of five years. The Na will have the option of extendin the charters up to a total of years.

Each of the new tankers will 595 feet long, have a 32-foot, inch draft, and displace 32,000 ton The ships will have a 12,000-mi steaming radius at 16 knots and w be conventionally powered.

Although this contract is the lar est in amount of any MSTS co tract involving the charter-build co cept, it is not the first employin this means of acquiring ship cha ters. The same concept was employ in 1964 when MSTS bareboat-cha tered the tanker SS Shenandoah, an in 1967 when MSTS time charter the gas turbine roll-on/roll-off car ship, GTS Admiral William Callagha

Avionics Laboratory Critical to Air Force Technical Effort

Colonel James L. Dick, USAF

When the Air Force produced its 38 Technical Objective Documents (TODs)[1] to delineate major requirements for technical effort, the Air Force Avionics Laboratory (AFAL) found that it was assigned 9 of the 38—the largest number of these TODs pursued by a single organization.

This extensive involvement gives one indication of the breadth of subject matter handled within the Avionics Laboratory. Another indication is that approximately 400 industries, universities, and research foundations are sharing the $80-million annual research and development budget and the 821 contracts currently administered by the laboratory for the studies, reports and hardware required to cover the span of AFAL's interests.

An additional $10 million annually supports the "in-house" operations of the laboratory which includes laboratory facilities, personnel, test gear and all types of supplies from private contractors and industries.

While individual contracts awarded through the Avionics Laboratory seldom reach the $1 million figure, the variety and type of work done by its industrial suppliers are extensive, sophisticated and often both scientifically and intellectually exciting. Based on rough estimates, there are over 600 industrial organizations in the nation with the facilities, proven technical abilities, and quality controls needed to make major contributions to the work of the laboratory.

If this 600 "guesstimate" seems unduly restrictive, consider the types of projects which the Avionics Laboratory is handling. The following examples have come to public attention just in the past year:

• LOCATING System. The laboratory attacked the sticky problem of the high cost of inertial navigation systems by setting up a special unit for the in-house design and developing of the Low Cost Aircraft Inertial Navigation (LOCATING) system. This system is a composite of components from various manufacturers and has achieved its goal quite well. Flight tests of the low cost system showed the performance well within design goals. Industry has received a very significant incentive to carry the success of this effort still further and make inertial navigation widely available.

• TAPIT. To transform a fighter aircraft into a reconnaissance plane, a contract with CBS/ Laboratories undertook to create a new *TA*ctical *P*hotographic *I*mage *T*ransmission system. Mounted in a pod under the wing, this apparatus takes motion pictures, develops them in seven seconds, and transmits them to a ground station. It allows a fighter plane loitering in the combat zone to send pictures immediately to military commanders in the field. An important element of the system is a 3/4-ton truck housing the ground station. Electronic signals arrive there from the aircraft and are immediately transformed into photographs for the ground commander.

• Solid State Image Sensor. The David Sarnoff Research Center of the Radio Corporation of America is fabricating an all thin film mosaic image sensor with integrated scanning that permits operation as an image pickup camera. The presently achieved 256-by-256 array, compared to 512 lines in conventional television, has potential high reliability and low cost through vacuum evaporation of solid state active and passive devices. The resulting images from this array can be displayed on a standard television monitor, thus providing cost savings and versatility.

• Optical Collimator. Corning Glass and the American Optical Co. combined to produce and polish the 103-inch diameter mirror which is the heart of this collimator, believed to be the largest and most precise in the world. Housed in its own air conditioned building, the completed instru-

[1] *See article, "U. S. Air Force Technical Objective Document Program,"* Defense Industry Bulletin, *December 1968, page 14.*

Colonel James L. Dick, USAF, is Director of the Air Force Avionics Laboratory. He previously served as Vice Commander, Air Force Cambridge Research Laboratories. He holds a doctorate in chemistry from Ohio State University.

ment will become a unique research tool for studying problems of optics and photography.

• Laser Communication System. Still in an early phase of development, this system can transmit 50 million elements of information per second—a capacity that equals 10 television stations broadcasting simultaneously. Its goal is 100 million elements per second, and its prospective use involves interplanetary transmissions, security (because the narrow laser beam is difficult for hostile forces to "jam or intercept), and the exploitation of scientific advantages which may arise once the engineers are free of the limitations imposed by electronic circuitry. The laser system was built by the Stanford Research Institute using certain basic techniques developed by researchers at the Avionics Laboratory's Electronic Technology Division—an example of the interplay that frequently exists between the laboratory and its suppliers.

• MERA. MERA is an electronically scanned all solid state phased array radar under development by Texas Instruments, Inc. This system combines the reliability advantages of solid state devices with the redundancy of a multi-element active antenna consisting of discrete transmitter-receiver modules. The advantages of such a system include a rapid scan and agile beam capability without the weight and high scan power required for conventional phased array antennae.

Avionics, for those not acquainted with the term, has been defined as: "technology combining concepts, airborne sensors (electromagnetic and inertial), data processing and data transmission to provide decision-making by man and control of his weapons to the target." The word was coined to represent a field of endeavor that sprang up during World War II, when it was discovered that an aircraft without 'round-the-clock capability was only a half-way effective weapon of war. Radar was frantically applied to the bomb-directing and fire-control functions, and electronic circuits were hastily developed to assist in navigation, aerodynamic and engine control, and surveillance. Within a few years we had created a new, versatile and most deadly weapon.

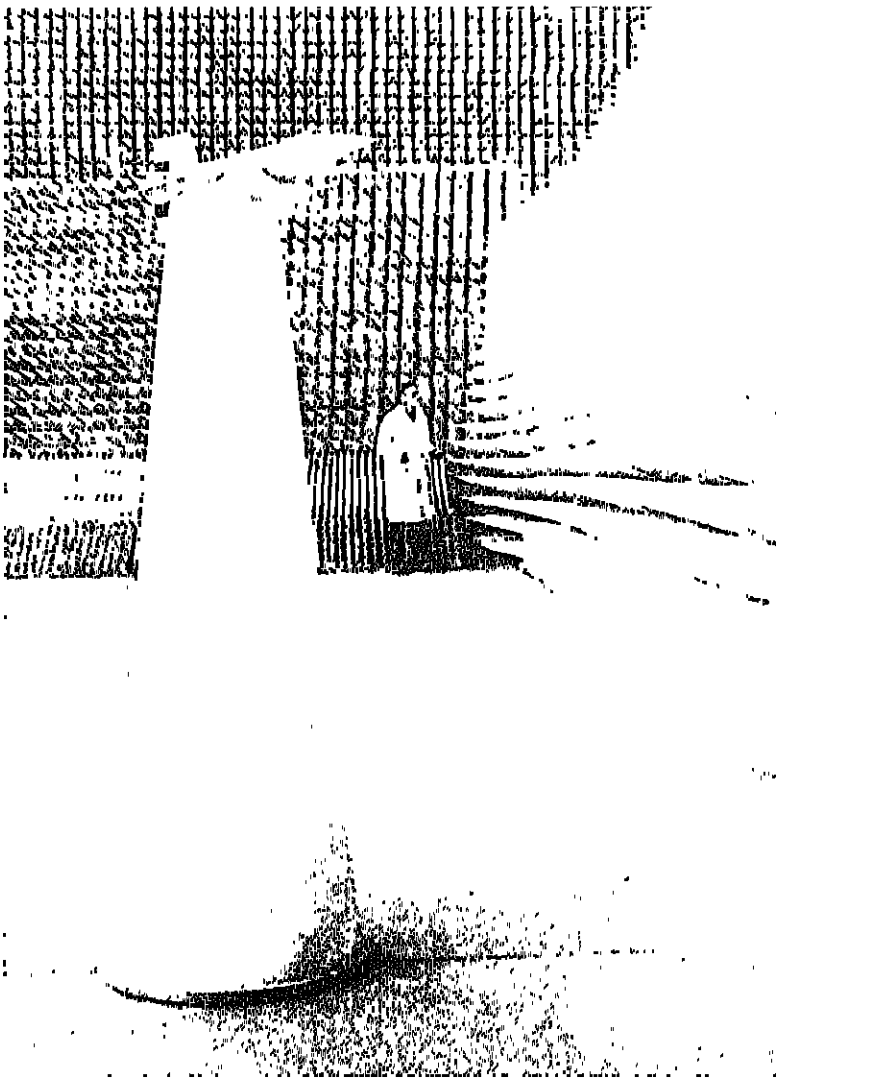
The goal of avionics now, as then, is the discovery of new techniques that will produce more effective Air Force systems and the attainment of component and circuit reliability essential to space age technology. Work toward these goals has led to a revolutionary merging of technical disciplines, adapting such sciences as biology, physics, mathematics and engineering into a smoothly integrated entity.

Because of its Air Force mission orientation, the Avionics Laboratory finds itself directly engaged in the support of Air Force operations wherever hostilities break out. Today great emphasis is being placed on reconnaissance work and weapons fire control to aid our forces in Southeast Asia.

With better than 75 percent of its total budget going to industries an[d] to university and research foundatio[n] organizations, the laboratory acts a[s] a considerable stimulus to the scien[-]tific community. It supports areas o[f] technology beneficial to the Air Forc[e] and where industry should and ca[n] become proficient.

The opposite side of the fence [h]as worked also. As a technology referra[l] center for numerous governmenta[l] agencies like the Aeronautical Sys[-]tems Division, the Space and Missil[e] Systems Organization, the Electroni[c] Systems Division, and others, the lab[-]oratory furnishes technical consulta[-]tion to evaluate the proposals thes[e] agencies receive from industry an[d] undertakes programs responsive t[o] their technical needs. The laborator[y]

ANECHOIC CHAMBER for experimental work on problems of radar echo fro[m] Air Force vehicles is checked by an engineer prior to a test. The walls of th[e] chamber are covered with spikes of rubber-like material impregnated wit[h] carbon to absorb, rather than reflect, radar signals. The target in this test a model of the X-15 research aircraft (on support at left), can be measure[d] in reflectionless surroundings, such as would occur in flight.

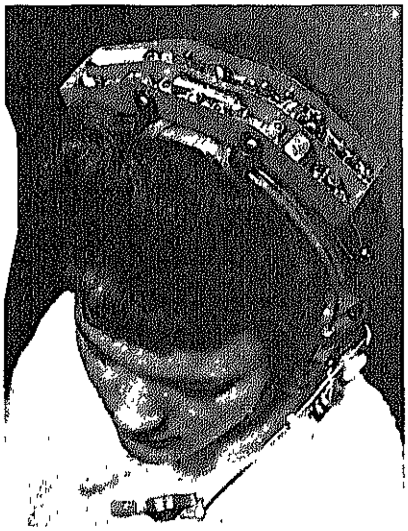


also acts as the focal point of the Air Force Systems Command for information in its technical areas and, in addition, works closely with the Army, Navy, National Aeronautics and Space Administration, Advanced Research Projects Agency, and other governmental agencies in aiding developments in these fields.

The calibre and diversity of the laboratory's own scientific effort has repeatedly proved a major advantage to industries grappling with Air Force scientific projects. Its nearly 600 scientists, engineers, technicians and support personnel are organized into four divisions: Navigation and Guidance, Reconnaissance, Electronic Technology and Electronic Warfare. In these divisions they are actively engaged in research efforts on electronic plasmas and solid state surfaces, in development programs of aerial photography, position and motion sensing, inertial navigation, optronics, solid state microwave and millimeter wave electronics, large scale integrated circuits, avionic and satellite communications, electronic countermeasures, laser technology, radar, infrared and ultra-violet, and a host of other programs to attack the many and varied avionic problems of the Air Force.

Early in 1968 the laboratory was honored with the Air Force Outstanding Unit Award for achieving "major technological advancements and contributions to the security and overall scientific well-being of the nation." The laboratory's technical manpower is in continuous demand to serve on Air Force and DOD committees and study groups. Industry has routinely used guidance from the laboratory in developing its own independent research and development programs. In all of these fashions the Air Force Avionics Laboratory is accomplishing its mission: to sponsor and advance the avionics technology; and to be ready to furnish aid and guidance to other government agencies, research centers and industry toward the prompt and cost-effective solution of the Air Force needs.

Interested persons are invited to write for a free booklet, "Air Force Avionics Laboratory, Aerospace Electronics Research", which describes the work and organization of the laboratory in detail. Address: Air Force Avionics Laboratory, Attn: AVO-2, Wright-Patterson AFB, Ohio 45433.



XPERIMENTAL CORDLESS EADSET for voice communications tween crewmen is demonstrated by Avionics Laboratory employee. Reacing the cord with a radio link ees crewmen from being "tied" to eir equipment. The device, deloped by the laboratory's Communitions Branch, could be used where restricted mobility is desirable, in craft, space vehicles and for comunications in ground maintenance.

Industrial Security Courses Scheduled in California

Field extensions of the Industrial Security Management Course have been scheduled for San Francisco and San Diego, Calif.

The San Francisco area course will be held June 2–6 at the Thunderbird Hotel, 101 Bayshore Freeway, Millbrae, Calif. The same course will be convened in San Diego June 9–13 at a site to be announced later.

Contractors desiring reservations for the San Francisco course should send requests to Merle Basom, Defense Contract Administration Services Region, San Francisco, 866 Malcolm Road, Burlingame, Calif. 94010. For information call (415) 692-0300, ext. 222.

Contractors interested in the San Diego course should contact Joseph C. Sullivan, Defense Contract Administration Services Region, Los Angeles, 11099 S. LaCienega Blvd., Los Angeles, Calif., 90045, or call (213) 643-0192 or (213) 643-1086.

DOD SETS JOINT BOARD FOR LOGISTICS REVIEW

The Defense Department has established a Joint Logistics Review Board to review world-wide logistics support to combat forces during the Vietnam era, in order to identify strengths and weaknesses and make appropriate recommendations for improvement.

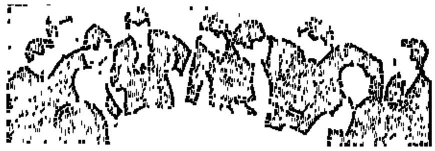
Findings and recommendations of the board will be submitted directly to the Secretary of Defense and the Chairman of the Joint Chiefs of Staff by March 1, 1970. Upon completion of its final report, the board will be dissolved unless otherwise determined by the Secretary of Defense at that time.

General Frank S. Besson Jr., former Commanding General of the U. S. Army Materiel Command, has been appointed the chairman of the board. In addition to General Besson, the board's membership consists of a senior general or flag officer representing each Military Service, the Defense Supply Agency, and appropriate representation from the Joint Staff of the Joint Chiefs of Staff.

Board members assigned are:

- Lieutenant General Lewis L. Mundell, former Vice Commander, Air Force Logistics Command, as U. S. Air Force representative.
- Lieutenant General Frederick L. Wieseman, recalled from retirement to be U. S. Marine Corps representative.
- Vice Admiral (designee) Edwin B. Hooper, formerly Assistant Deputy Chief of Naval Operations (Logistics), as U. S. Navy representative.
- Lieutenant General (designee) Oren E. Hurlbut, formerly Commanding General, U. S. Army Weapons Command, as U. S. Army representative.
- Rear Admiral John W. Bottoms, former Commander Officer, U. S. Naval Supply Center, Norfolk, Va., as Defense Supply Agency representative.

Representatives of the Joint Staff are Colonel H. T. Casey, USA, and Colonel John W. Hanley, USAF. The board will be augmented by a staff furnished by the Military Services.



MEETINGS AND SYMPOSIA

APRIL

Ocean Science & Technology Advisory Committee Annual Meeting, April 23–24, at the West Auditorium of the State Department, Washington, D.C. Sponsor: National Security Industrial Assn. Contact: John H. Jorgenson, Committee Executive, National Security Industrial Assn., Suite 800, 1030 15th St., N.W., Washington, D.C. 20005, Phone (202) 296–2266.

Army Numerical Analysis Conference, April 24–25, at Walter Reed Army Institute of Research, Washington, D.C. Sponsor: Army Research Office—Durham. Contact: Dr. Francis G. Dressel, Mathematics Div., Army Research Office-Durham, Box CM, Duke Station, Durham, N.C. 27706, Phone (919) 286–2285.

Thin Films—Structure Sensitive Properties Conference, April 28–May 2, at Boston, Mass. Sponsors: Army Research Office—Durham and the National Aeronautics & Space Administration. Contact: Dr. Robert Mace, Dir., Physics Div., Army Research Office—Durham, Box CM, Duke Station, Durham, N.C. 27706, Phone (919) 286–2285.

Electronic Systems on the Horizon Advance Planning Briefing for Industry, April 29–May 1, at the Hexagon, Fort Monmouth, N.J. (Classified Secret). Sponsors: U.S. Army Electronics Command and the Armed Forces Communications-Electronics Assn. Contact: Technical & Industrial Liaison Office, U.S. Army Electronics Command, Fort Monmouth, N.J. 07703, Phone (201) 535–2240.

Defense Readiness and Logistics Symposium, April 30, at Fort Lesley J. McNair, Washington, D.C. Sponsors: Industrial College of the Armed Forces and the Defense Supply Assn. Contact: Capt. James K. Webster, USN (Ret.), Defense Supply Assn., 1026 17th St., N.W., Washington, D.C. 20036.

MAY

American Society for Quality Control Annual Technical Conference, May 5–7, at the Biltmore Hotel, Los Angeles, Calif. Sponsor: American Society for Quality Control. Contact: Robert W. Shearman, Admin. Secretary, American Society for Quality Control, 161 W. Wisconsin Ave., Milwaukee, Wis. 53203, Phone (414) 272–8575.

Third Annual **Military History Symposium**, May 8–9, at the U.S. Air Force Academy, Colo. Sponsor: Department of History, Air Force Academy. Contact: Lt. Col. William Geffen, Executive Dir., Military History Symposium, Department of History, U.S. Air Force Academy, Colo. 80840, Phone (303) 472–2316.

American **Helicopter Society National Forum**, May 14–16, at Washington, D.C. Contact: Harry M. Lounsbury, American Helicopter Society, 141 East 44th St., New York, N.Y. 10017, Phone (212) OXford 7–5168.

The Influence of Microelectronics on Management Decisions Conference, May 27–28, at the Mayflower Hotel, Washington, D.C. Sponsors: Defense Department and the National Security Industrial Assn. Contact: Paul A. Newman, National Security Industrial Assn., 1030 15th St., N.W., Washington, D.C. 20005, Phone (202) 296–2266

JUNE

Armed Forces **Communications-Electronics Assn. Annual Convention**, June 3–5, at the Sheraton-Park Hotel, Washington, D.C. Contact: W. J. Baird, Armed Forces Communications-Electronics Assn., 1725 Eye St., N.W., Washington, DC. 20006, Phone (202) 296–3033.

Army **Mathematicians Conference**, June 11–12, at St. Louis, Mo. Sponsors: Army Research Office—Durham and the Army Mathematics Steering Committee. Contact: Dr. Francis G. Dressel, Mathematics Div., Army Research Office—Durham, Box CM, Duke Station, Durham, N.C. 27706, Phone (919) 286–2286, Ext. 75.

Planning Challenges of the 1970s in Space and the Public Domain Meeting, June 17–20, at the Brown Palace Hotel, Denver, Colo. Sponsors: American Astronautic Society and the Operations Research Society of America. Contact: Dr. George W. Morgenthaler, General Program Chairman, Martin Marietta Corp., P.O. Box 179, Denver, Colo. 80201, Phone (303) 794–5211, Ext. 4557.

Aerodynamics Problems Associated with Helicopters and V/STOL Aircraft Meeting, June 18–20, at Buffalo, N.Y. Sponsors: Army Aviation Materiel Laboratories and Cornell Aeronautical Laboratory, Inc. Contact: John E. Yeates, Aerodynamics Div., Army Aviation Materiel Laboratories, Fort Eustis, Va. 23604, Phone

International **Shock Tube Symposium**, June 23–25, at the University of Toronto, Canada. Sponsor: Air Force Office of Aerospace Research. Contact: M. Rogers, Air Force Office of Scientific Research (SREM), 1400 Wilson Blvd., Arlington, Va. 22209, Phone (202) OXford 4–5568.

Center for High Energy Forming International Conference, June 23–27, at Estes Park, Colo. Sponsor: Army Materials and Mechanics Research Center. Contact: A. F. Jones, Associate for Technology, Army Materials and Mechanics Research Center, Watertown, Mass. 02172, Phone (617) 926–1900, Ext. 401.

JULY

Environmental Effects on Antenna Performance Meeting, July 7–18, at Boulder, Colo. Sponsors: Air Force Cambridge Research Laboratories and the Environmental Science Services Administration. Contact: Philip Blacksmith, Air Force Cambridge Research Laboratories (CRDG), L. G. Hanscom Field, Mass. 01730, Phone (617) 274–6100, Ext. 3704.

National Seminar of the **National Classification Management Society**, July 22–24, at the Mayflower Hotel, Washington, D.C. Contact: James J. Bagley, Seminar Chairman, Naval Research Laboratory, Washington, D.C. 20390, Phone (202) 574–2391.

"Truth in Negotiations"

An Audit Task of the Defense Contract Audit Agency

William B. Petty

One of the most discussed aspects of government contracting today is "defective pricing." Defective pricing clauses which are currently being inserted into certain defense contracts are the result of Public Law 87–653, commonly referred to as the "Truth in Negotiations" Act. The purpose of this article is to discuss Defense Department implementation of Public Law 87–653, primarily in terms of the responsibilities assigned to the Defense Contract Audit Agency.

Background

While defective pricing is currently receiving widespread attention within industry and Government, it is not a new subject. As early as 1958, the Air Force required certain certifications of costs by contractors. Starting about 1959, the General Accounting Office issued a series of reports criticizing the Defense Department for failure to achieve sound contract prices in negotiated contracts. In 1961, the Armed Services Procurement Regulation (ASPR) was amended to require defense contractors to furnish cost or pricing data in certain circumstances, and to certify that the data was accurate, complete and current. Despite the incorporation of these requirements in the ASPR, the General Accounting Office continued to report overpricing resulting from contractors' failures to submit the required data, or the failure of the Defense Department to disclose that such data were defective. These reports were a major factor influencing the passage of Public Law 87–653, effective Dec. 1, 1962.

What was the philosophy that brought Public Law 87–653 into being? Here are a few examples:

- There were too many instances in which contractors, negotiating for defense business, took advantage of favored positions as sole source suppliers and succeeded in getting unjustified prices. This was accomplished by introducing improper estimates of costs where the contractor should have known better.
- Because of the climote in which many pre-award evaluations and negotiations are conducted, government personnel could not hope to smoke out all errors or omissions before contract award.
- Some mechanism was needed for contract adjustments where defective cost data resulted in unreasonable prices.
- The law itself would influence the contractors to be more thorough, more accurate, more complete, and more current in preparing price proposals.

Public Law 87–653 was intended to give the Government a legal right to adjust the contract price, where the contract price was based on inaccurate, incomplete, or noncurrent cost or pricing data. It is important to note that Congress deemed it necessary to put the full force and effect of law behind pricing requirements, even though the provisions of the law were already substantially covered in the ASPR.

After enactment of the law, the ASPR was amended to conform to statutory provisions. However, there was a gap in the ASPR coverage in that no particular agency or activity in defense procurement was given direct responsibility for conducting a specific and definite program for assuring compliance with the law. For example, contract administration people were knowledgeable about the law, but they had no good way to find out whether contractors were observing it. Contract auditors had been instructed to report instances of defective pricing which came to their attention as they went about their regular audit work. However, relatively few instances of defective pricing were brought to the contracting officers' attention so that they could deal with them.

William B. Petty is Director, Defense Contract Audit Agency, a position he has held since its organization. Previously, he was Deputy Comptroller of the Air Force. During his military service career, he served in auditor general assignments. He was graduated from the University of Illinois, and is a Certified Public Accountant.

The General Accounting Office meanwhile continued to audit in this area and, late in 1965, issued a report which recommended, among other things, that the Defense Contract Audit Agency (DCAA) should be required to establish a formal program for conducting defective pricing reviews. The Defense Department adopted this recommendation and DCAA was delegated this responsibility.

One can readily recognize the difficulties inherent in this entire program. The real question is whether a contractor, who provides cost or pricing data and executes a pricing certificate, has made known to the contracting officer—at the proper time in the negotiation and contracting process—all matters then known to him which influence the contract price. Who knew what, at exactly what time, is not easily determined. It is very difficult, in many circumstances, for the Government to prove defective pricing, even if it does exist; and it is equally difficult for a contractor to defend himself against it for exactly the same reasons.

DCAA Responsibilities

By DCAA Regulation 7640.6, issued March 1966, the Defense Contract Audit Agency formally established a program for regularly scheduled post-award reviews of selected contracts, to determine compliance with Public Law 87-653. A copy of this regulation was published in the Congressional Record and in various information media to which contractors subscribe.

The regulation states that "the objective of a defective pricing review consists of a factual determination that all information or data available to the contractor was either properly or improperly reflected, by cost element, in the contractor's proposal." To meet this objective, DCAA's responsibility is to select contracts for review, make the examinations, reach a conclusion about whether defective pricing exists, and prepare a report to the cognizant contracting officer. The contracting officer is responsible for deciding whether defective pricing exists, and then for dealing with the contractor to obtain appropriate contract adjustments.

There are several considerations that DCAA auditors recognize in conducting defective pricing reviews:

- That the purpose of the review is to determine whether there has or has not been compliance by the contractor with the Public Law 87-653 —no more and no less.
- That an audit is being conducted, not an investigation.
- That the chronology of events is extremely important—"what" happened "when" is often the real question.
- That any findings and recommendations must be well founded and provable. The burden of proof is on the Government.

Throughout the agency, we recognize that all contracts with defective pricing clauses cannot possibly be examined. Therefore, a program has been developed for selecting contracts for review to ensure that DCAA is adequately accomplishing its portion of the total DOD responsibility under the law. In selecting these contracts, we are strongly influenced by the confidence—or lack of confidence—we have in the reliability of contractor's proposals, based on our past experience.

Progress in Program Performance

The fiscal year that ended June 30, 1968, is the first year which could be considered representative of our progress in performing defective pricing reviews. During that year we examined, for defective pricing purposes, 582 contracts and subcontracts, with a total contract value of about $3.8 billion. Of this number, we found 104 contracts where there were indications of inaccurate, incomplete, or noncurrent pricing data. We recommended contract adjustments of $18.6 million.

Since DCAA was organized in July 1965, we have made defective pricing reviews on 953 contracts with a total value of about $9 billion, and have identified 146 in which the cost or pricing data appears to have been defective, recommending about $32 million in contract adjustments. However, we cannot assess the true savings to the Government as the result of our work at this point in time.

After we release an audit report in which contract adjustments are recommended, the contracting officer then enters into discussions with the contractor. These discussions, and a final decision about what should be done, are often time consuming. Therefore, the final outcome of all reports which we have issued is not known. Information that is available indicates that where settlements have been reached, out of $6.8 million which we have proposed, contracting officers have made contract adjustments of $4.7 million, with net final savings of $2.7 million.

It should be recognized that many of the contracts which we have reviewed as of this point in time were awarded in 1965 and 1966. Since that time, DOD has made a very strenuous effort to cause contractors to improve the quality of cost and pricing data which they submit. It is entirely possible, if these efforts are productive, that we will, in the future, identify fewer instances of defective data in relation to the total number of contracts examined.

There should also be an improvement in the quality of cost and pricing data as a result of the DOD program for survey and evaluation of contractor estimating methods and procedures. This program is also the responsibility of the Defense Contract Audit Agency. As of Dec. 31, 1968, we have surveyed and reported on more than 200 estimating systems. We believe this program has been quite productive in influencing contractors to more painstakingly prepare their price proposals, and to prepare them in an environment where better internal and managerial control is brought to bear.

What Is and What Is Not Defective Pricing?

The questions could be asked, "What is defective pricing?" and "What is not defective pricing?" I cannot give a complete and all inclusive answer to either question, but experience may be of some help.

Circumstances that are not defective pricing.

Illustrations of circumstances which will *not*, in and of themselves, support findings of defective pricing are:

- Subsequent to the award of the contract, a significant difference is noticed between proposed costs and experienced costs.
- After completion of the contract, it is found that the profit actually realized on the contract was higher than profit contemplated at the time of negotiation.

- Subsequent to the completion of the contract, it turns out that contingency provisions proposed to and accepted by the contracting officer did not materialize.
- The original proposal disclosed facts as to historical costs, but projected that costs for the future would be higher, and such projections accepted by the contracting officer did not materialize.
- Estimates (or judgment) contained in the original proposal turned out to be wrong, *e.g.*, labor productivity was higher than anticipated; or actual cost of an item of material was less than proposed, due to such conditions as changes in market conditions or an advantageous buy.

Circumstances that indicate defective pricing.

Conversely, the following illustrate circumstances which may be the basis for findings of defective pricing:

- Subsequent to submission of the original proposal but prior to agreement on price, firm quotations are received or purchase orders are awarded at prices significantly less than those indicated in the original proposal. This information was not disclosed to the contracting officer.
- The original proposal was supported in part by a "priced out" bill of material which, subsequent to agreement on price, was found by the Government to have been overstated because the costing data used were obsolete. For example, firm quotations received from suppliers, prior to agreement on price, bid prices substantially less than purchase order prices from a prior contract which had been used to "price out" the bill of material.
- The original proposal contained a "make or buy" plan stating which parts or components were to be bought and which were to be made in-house; however, prior to agreement on price, the "make or buy" plan was changed in a manner which resulted in incurrence of significantly less costs. Such a change was evidenced by a series of plant work orders, providing for in-house manufacture of a number of parts and components that had been identified as "buy" items in the original "make or buy" plan. These data were not disclosed to the contracting officer.
- The labor estimate in th [illegible] 'gi- [illegible] tract for an item that was similar, but not identical, to the item to be contracted for; however, prior to agreement on price, a complete time and motion study for the item was performed which demonstrated that the labor estimate was overstated. These data were not disclosed to the contracting officer.
- The original proposal was based, in part, on the continued use of manufacturing processes and machinery utilized in the past; however, prior to agreement on price, a management decision was made to acquire new equipment and use new processes (to be used during the period of the contract). This decision was evidenced by the minutes of a board of directors meeting, fixed asset appropriations, and requests for quotations sent to suppliers for this new equipment. This decision was not disclosed to the contracting officer.
- The original proposal contained an estimate for overhead and general and administrative costs, based upon the overhead and general and administrative rates for the prior fiscal year; however, before agreement on price, the company's budgets for future production, sales, etc., approved by top management, indicated a sizable increase in volume, resulting in significant reductions in overhead and general and administrative rates. The data in these budgets were not disclosed to the contracting officer.

In summary, we find defective data in all major areas of cost. It is not confined to the material costs but runs the range of material, overhead, labor rates, failure to use past experience, make versus buy, duplicate charges, and subcontracting.

Living With the Law

How can contractors "live with" the law? Some key points for consideration by contractors are offered:

- Develop, formalize and use an estimating system to assure that cost data is prepared and submitted in a controlled environment.
- Speed up internal information flow to assure that all elements of the organization, which need knowledge of a subject at a particular point in time, have such knowledge.
- Be as certain as humanly possible that cost and pricing data submitted are accurate, complete and current. Remember that the language of the law provides for adjustment "to exclude any *significant* sums by which it may be determined . . . that . . . the price was increased because the contractor . . . furnished cost or pricing data which . . . was inaccurate, incomplete, or noncurrent." [Emphasis added.]
- Give more effort to compliance, and less effort to fighting the facts.
- Recognize that a government contractor deals with the public, and not with just any customer. Operating under a government contract will not be a business-as-usual environment.
- Be content with a reasonable profit for the work done.
- Be sure that complete disclosure is made to the contracting officer or his representatives of all matters known to the organization which have a bearing or influence on anticipated contractual costs.

Administration of the Law

Contractors should keep two things in mind in dealing with DCAA auditors under this program.

First, the Congress has felt the need for and has enacted this law. DCAA has the responsibility, delegated by the Defense Department, to assist in the administration and implementation of the law. To meet this responsibility, our objective is to perform this effort in such a manner that both the public and the contractors will receive fair and equitable treatment.

Second, in accomplishing its responsibility, DCAA's sole function is to perform defective pricing reviews and report findings to the contracting officers, who will consider our reports and decide if contract adjustments are in order.

How Public Law 87-653 affects a contractor is much more in his own hands than in the hands of the government people who administer the law. This is not an impossible or even an unreasonable law to observe. The law seeks to assure one thing—"truth in negotiations," so that the contracting parties may be fully knowledgeable about significant matters which affect the price when they meet to negotiate. If contractors do the kind of job they should in estimating prices and identifying the data they used, and if they make full disclosure of all significant matters to the contracting officers, there should be few instances where a contract adjustment is necessary.

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Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402.

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Navy Systems Performance Effectiveness Manual. Presents the concept and highlights of systems performance effectiveness and the steps in implementation. 1968. 64 p., il. D201.6/12:Sy8. 75¢.

MILSCAP, A DOD Data System. This brochure is intended to present an over-view of all contract administration, delivery, and financial aspects of MILSCAP, as well as acquaint the reader with related standardization efforts. 1968. 22 p. il. D7.2:M59/3. 20¢.

Dictionary of U.S. Military Terms for Joint Usage (Short Title: JD). Prepared under the direction of the Joint Chiefs of Staff in coordination with the Military Services for planning and operational usage. Terms and definitions, which have been approved for the NATO, SEATO, and CENTO Glossaries, are incorporated in this edition with those which have U.S. joint service approval. 1968. 322 p. D5.12:1/7. $2.

DEFENSE PROCUREMENT CIRCULARS

Distribution of Defense Procurement Circulars is made automatically by the U.S. Government Printing Office to subscribers of the Armed Services Procurement Regulation (ASPR).

Defense Procurement Circular No. 65, Dec. 20, 1968. (1) Effective date of ASPR Revision 30. (2) Late Bids, Offers, Proposals—General. (3) Special Late Proposals and Modifications Provision in Solicitations for ADPE Under Procurement Authority Delegated by GSA. (4) Index of 100 Companies Which Received the Largest Dollar Volume of Military Prime Contracts in FY 1968. (5) Educational or Nonprofit Institutions with Approved Patent Policies. (6) Cost Principles, BOB Circular A-87. (7) Small Business Size Standards. (8) Small Business—Construction Set-Asides. (9) DD Form 250–Material Inspection and Receiving Report. (10) Distribution of Procurement Documents. (11) Reporting of Labor Disputes. (12) Health and Safety Clauses. (13) Value Engineering.

Defense Procurement Circular No. 66, Jan. 2, 1969. (1) Equal Employment Opportunity (DPC No. 36). (2) Equal Employment Opportunity (DPC No. 46). (3) Price Adjustments in Contracts for Fluid Milk. (4) Postponement of Use of "DOES" Codes. (5) Use of Third-Country Nationals in Performance of Contracts in South Vietnam. (6) Establishment of CWAS Coordinating Group. (7) Public Law 87-653. (8) Equal Employment Opportunity. (9) Equal Employment Opportunity—Assurance of Nonsegregated Facilities.

Defense Procurement Circular No. 67, Jan. 31, 1969. (1) Cost Principles —BOB Circular A-87. (2) A Message From Asst. Secretary of Defense (Installations & Logistics). (3) Equal Employment Opportunity. (4) Reduction of Qualifications for "Certified Eligible" Concerns. (5) ASPR Manual and Supplements. (6) Aircraft, Missile, and Space Vehicle Accident Reporting and Investigation.

RESEARCH REPORTS

Organizations registered for service may obtain microfiche copies of these documents without charge from:
Defense Documentation Center
Cameron Station
Alexandria, Va. 22314

All organizations may purchase microfiche copies (65¢) or full-size copies ($3) of the documents (unless otherwise indicated) from:
Clearinghouse for Federal and Scientific Information
Department of Commerce
Springfield, Va. 22151

Frequency-Shift Keying Laser Communication Studies. Army Electronics Command, Fort Monmouth, N.J., April 1968, 144 p. Order No. AD-671 596.

Gyroscope Standard Gyrocompassing Accuracy Test. Air Force Systems Command, Holloman AFB, N.M., Dec. 1967, 41 p. Order No. AD-670 523.

Cost/Benefits of Technical Information Services and Technology Transfer. Defense Documentation Center, Alexandria, Va., July 1968, 297 p. Order No. AD-672 500.

Space Power Supply Study. Navy Space Systems Activity, Los Angeles, Calif., May 1968, 178 p. Order No. AD-672 722.

Development and Test of the E gine Analyzer System. Air Force S tems Command, Wright-Patter AFB, Ohio, Aug. 1967, 171 p. Or No. AD-665 158.

The Deflection of Plane Turbulen Jets by Convex Walls. Naval Post graduate School, Monterey, Calif., June 1968, 54 p. Order No. AD-673 249.

Weather Forecasting Methods (A DDC Bibliography). Defense Docu mentation Center, Alexandria, V Aug. 1968, 305 p. Order No. AI 175.

U.S. Army Research & Develo ment Information Program FY 196 FY 1972. Army Research Offic Washington, D.C., June 1968, 65 Order No. AD-672 844.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

The following key appointments, 'eappointments and nominations have een made in the Office of the Secre-ary of Defense:

Dr. John F. Foster Jr. has re-ained his position as Dir., Defense lesearch & Engineering. VAdm. Vin-ent P. de Poix, USN, has been ap-pointed as Dep. Dir. (Administration valuation and Management).

Robert F. Froehlke has succeeded olis Horwitz as Asst. Secretary of efense (Administration). Mr. 'roehlke was sworn in Jan. 30. David). Cooke is serving as Acting Prin-pal Dep. Asst. Secretary.

Robert C. Moot has been reap-pinted as Asst. Secretary of Defense Comptroller). No changes have been ade of key officials in his office.

Barry J. Shillito was sworn in as ie new Asst. Secretary of Defense Installations & Logistics) Feb. 1. He icceeds Thomas D. Morris.

G. Warren Nutter has replaced aul C. Warnke as Asst. Secretary Defense (International Security ffairs).

Robert T. Kelley has succeeded lfred B. Fitt as Asst. Secretary of efense (Manpower & Reserve Af-irs). VAdm. William P. Mack, SN, will serve as his Dep. Asst. ecretary replacing Lt. Gen. J. B. impert, USA.

Daniel Z. Henkin is serving as Act-Asst. Secretary of Defense (Pub-Affairs). He replaces Phil G. oulding. Mr. Henkin served as Dep. st. Secretary under Mr. Goulding. chard G. Capen Jr. and Jerry W. iedheim have been designated as r. Henkin's deputies.

Dr. Ivan Selin is serving as Acting st. Secretary of Defense (Systems ialysis). He replaces Alain Enthov-. Dr. Selin joined the Defense De-rtment in 1965 and has been serv-

Headquarters Allied Powers Europe. Gen. Parker retired Feb. 1.

Capt. Robert R. Campbell, USN, has been assigned to command the Defense Contract Administration Services, Region, Boston, Mass.

Col. James T. Jones, USAF, and Col. Philip C. McMullen, USAF, have been assigned to the Defense Atomic Support Agency, Sandia Base, N.M. Col. Jones is the new Dir. of Test Operations. Col McMullen will serve as Dep. Dir. of Test Command.

Col. Stewart C. Meyer, USA (brigadier general designate) is now serving as assistant to the Dep. Dir., Defense Research and Engineering (Tactical Warfare Programs).

DEPARTMENT OF THE ARMY

Secretary of Defense Laird has announced three nominations for positions in the Department of the Army. They are: Thaddeus R. Beal for assignment as Under Secretary of the Army; William K. Brehm to continue as Asst. Secretary of the Army (Manpower & Reserve Affairs); and Eugene M. Becker for reappointment as Asst. Secretary of the Army (Financial Management).

Lt. Gen. Ferdinand J. Chesarek has been named to replace Gen. Frank S. Besson Jr. as Commanding General, Army Materiel Command. He was promoted to four-star rank with the assignment. Gen. Chesarek is a native of Calumet, Mich., where he was born Feb. 18, 1914. He was graduated from West Point in 1938. He served as Comptroller of the Army from August 1966 to August 1967 and served as Asst. Vice Chief of Staff, U.S. Army before assignment as head of the Army Materiel Command.

Gen. Besson has been reassigned to duty as Chairman, DOD Joint Logistics Review Board.

Maj. Gen. William E. DePuy has een assigned to replace Gen. Chesa- Asst. Vice Chief of Staff, U.S.

J. Lang, has been selected to be Commander, Military Traffic Management & Terminal Service (MTMTS). He replaces Maj. Gen. John J. Lane, who has retired.

Maj. Gen. David P. Gibbs has been recalled from retirement as an adviser and consultant to the U.S. program-project manager for the Mallard Project.

Dr. William L. Archer has been appointed Scientific Advisor to the Commanding General of the Institute of Land Combat, an element of Army Combat Developments Command, Fort Belvoir, Va.

Dr. Russell D. Shelton has succeeded Dr. Edward K. Kaprelian as Technical Dir., Army Limited War Laboratory, Aberdeen Proving Ground, Md.

William B. Taylor has been selected as Technical Dir., Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

Army Combat Developments Command, Fort Belvoir, Va., announces the assignment of Col. Arthur S. Hyman as Dir. of Organization.

Col. Cornelius J. Molloy Jr. is the new Dir. of Infantry Materiel Testing at the Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

Col. William G. Stewart became the District Engineer, Army Corps of Engineers at Chicago, Ill., in March.

Lt. Col. Ralph A. Barker has been assigned to the Army Strategic Communications Command, East Coast Telecommunications Center, as Commanding Officer.

Lt. Col. Philip A. Woolaver is now serving as Dep. Commander, Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

DEPARTMENT OF THE NAVY

Secretary of Defense Melvin R. Laird has announced five nominations for positions in the Department of the Navy. They are: John W. Warner to be Under Secretary of the Navy; Frank Sanders to be Asst. Secretary of the Navy (Installations

& Logistics); **James D. Hittle** as Asst. Secretary of the Navy (Manpower & Reserve Affairs); **Robert A. Frosch** to continue as Asst. Secretary of the Navy (Research & Development); and **Charles A. Bowsher** to continue as Asst. Secretary of the Navy (Financial Management).

Two new assignments have been made in the Office of the Chief of Naval Operations. **RAdm. William N. Leonard** will serve as Asst. Dep. Chief of Naval Operations (Development). **Capt. Robert B. Baldwin** (rear admiral selectee) is the new Dir., Aviation Program Div.

RAdm. George M. Davis Jr. (Medical Corps) has been selected as Chief of the Bureau of Medicine and Surgeon General of the Navy.

Capt. Max H. Allen has been assigned duty as Commanding Officer, Naval Public Works Center, Great Lakes, Ill.

Capt. Don E. Hihn has been selected as Commanding Officer, Naval Weapons Station, Charleston, S.C.

Capt. Daniel M. Karcher will serve as the new Project Manager, Navy Logistics Information System Project, Naval Material Command.

Capt. Donald H. Kern has been named as the new Commanding Officer of the Portsmouth, N.H., Naval Shipyard.

DEPARTMENT OF THE AIR FORCE

The Secretary of Defense has announced three nominations for positions in the Office of the Secretary of the Air Force. They are: **John L. McLucas**, to be Under Secretary of the Air Force; **Curtis W. Tarr**, to be Asst. Secretary of the Air Force (Manpower & Reserve Affairs); and **Grant L. Hansen**, to be Asst. Secretary of the Air Force (Research & Development).

Gen. Joseph R. Holzapple has been assigned the Commander-in-Chief, U.S. Air Forces in Europe, and Commander, Fourth Allied Tactical Air Force. Gen. Holzapple was promoted to the rank of general with the assignment.

Also announced was the assignment of **Lt. Gen. Marvin L. McNickle** as Dep. Chief of Staff (Research and Development), Hq., USAF.

The following named brigadier generals have been nominated for appointment to the grade of major general:

Clifford J. Kronauer Jr., Commander, Air Force Western Test Range, Vandenberg AFB, Calif.; **Russell K. Pierce Jr.**, Commander, Air Weather Service, Military Airlift Command, Scott AFB, Ill.; **Franklin A. Nichols**, Commander, Ground Electronics Engineering Installation Agency, Griffiss AFB, N.Y.; **Paul R. Stoney**, Vice Commander, Air Force Communications Service, Scott AFB, Ill.; **Kenneth W. Schultz**, Dep. for Minuteman, Space & Missile System Organization, Norton AFB, Calif.; **William F. Pitts**, Dep. Dir. of Budget, Office of Air Force Comptroller, Hq., USAF; **Louis L. Wilson Jr.**, Vice Commander, Space & Missile Systems Organization, Los Angeles, Calif.; **Felix M. Rogers**, Dep. Chief of Staff (Development Plans), Hq., AFSC, Andrews AFB, Washington, D.C.; and **William W. Snavely**, Vice Commander, Oklahoma City Air Materiel Area, Tinker AFB, Okla.

The following named colonels have been nominated for appointment to the grade of brigadier general:

James O. Frankosky, Dep. Dir., Strategic & Defense Forces, Office of Dep. Chief of Staff, Research & Development, Hq., USAF; **Jessup D. Lowe**, Commander, Air Force Satellite Control Facility, Los Angeles, Calif.; **Vernon R. Turner**, Commander, Air Force Data Systems Design Center, Bolling AFB, Washington, D.C.; **Thomas P. Coleman**, Public Affairs Officer, Pacific Command; **Peter R. DeLonga**, Chief, Logistics Operations Div., Office of Dep. Chief of Staff, Systems & Logistics, Hq., USAF; **Charles I. Bennett Jr.**, Executive to Chief of Staff, Hq., USAF; **James R. Pugh Jr.**, Chief, Procurement & Production Div., F-111 System Program Office, Wright Patterson AFB, Ohio; **Brian S. Gunderson**, Exec. Asst. to the Secretary of the Air Force; **Geoffrey Cheadle**, Exec. to Commander, AFSC, Andrews AFB, Washington, D.C.; **Floyd H. Trogdon**, Vice Commander, Electronic Systems Div., AFSC, L. G. Hanscom Field, Mass.; **Harold L. Collins**, Chief, Aerospace Systems Div., Office of Dep. Chief of Staff, Research & Development, Hq., USAF; **Benjamin N. Bellis**, Dep. for Recon., Aeronautical Systems Div., AFSC, Wright-Patterson AFB, Ohio; **Lew Allen Jr.**, Dep. Dir., Advanced Plans, Directorate of Special Projects, Office of the Secretary of the Air Force; **Billie J. McGarvey**, Dep. Chief of Staff (Civil Engineering), AFLC, Wright-Patterson AFB, Ohio.

Two assignments have been listed by Hq., USAF: **Col. William D. Hatcher** as Asst. Dir., of Information and **Col. Henry B. Stelling, Jr.** as Asst. Dep. Dir for Advanced Development, with duty station at the Directorate of Special Projects, Los Angeles, Calif.

Assignments to key positions within the Air Force Systems Command are:

Col. William K. Bailey, Dir. of Development Engineering, Air Force Contract Management Div., Los Angeles, Calif.; **Col. Arthur W. Banister**, Chief, Systems Engineering Satellite Control Facility, Los Angeles, Calif.; **Col. William D. Baxter**, Dir., Mission Module, Space & Missile Systems Organization, Los Angeles, Calif.; **Col. Joseph M. Dubois**, Chief, Propulsion Subsystems Div., Aeronautical Systems Div., Wright-Patterson AFB, Ohio; **Col. Gonzalo Fernandez**, Dep. Dir., Test Ops, Manned Orbiting Lab, Space & Missile Systems Organization, Los Angeles, Calif.; **Col. John R. Hansen**, Dir., Development Engineering, Aeronautical Systems Div., Wright-Patterson AFB, Ohio; **Col. Milton S. Jones**, Chief, Aircraft & Missile Test Div., Armament Development & Test Center, Eglin AFB, Fla.; **Col. Robert T. Marsh**, Asst. Dep. for Recon., Aeronautical Systems Div., Wright-Patterson AFB, Ohio; **Col. Floyd H. Mason**, Dir., Engineering Standards, Aeronautical Systems Div., Wright-Patterson AFB, Ohio; **Col. Richard L. Miner**, Dep. Systems Prog. Dir., Advanced Manned Strategic Aircraft, Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

The following assignments to key positions have been made by the Air Force Logistics Command:

Maj. Gen. William H. Reddell, Vice Commander, San Antonio Air Materiel Area, Kelly AFB, Tex.; **Col. Edward J. Bartlett**, Chief, Commodities Procurement Div., Sacramento Air Materiel Area, McClellan AFB, Calif.; **Col. Bruce E. Mills**, Chief, Research Div., Advanced Logistics Systems Center, Wright-Patterson AFB, Ohio; **Col. Charles Y. Schultz Jr.**, Vice Commander, Ground Electronics Engineering Installation Agency, Griffiss AFB, N.Y.; and **Col. Milton Stamatis Jr.**, Dir., Procurement Management, Hq., AFLC, Wright-Patterson AFB, Ohio.

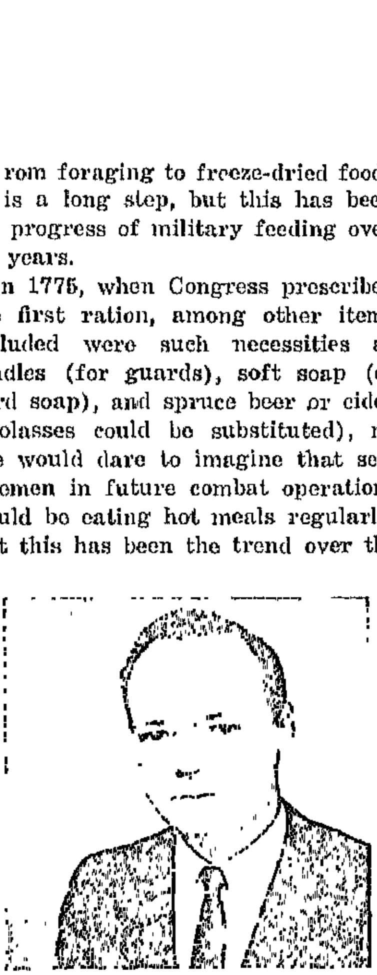
America's Largest Food Operation

Feeding the Troops

Herbert W. McCarthy

From foraging to freeze-dried foods is a long step, but this has been the progress of military feeding over the years.

In 1775, when Congress prescribed the first ration, among other items included were such necessities as candles (for guards), soft soap (or hard soap), and spruce beer or cider (molasses could be substituted), no one would dare to imagine that servicemen in future combat operations would be eating hot meals regularly. Yet this has been the trend over the years until, in Vietnam, over 90 percent of the meals served to our personnel are hot meals consisting of the same food items that are served in garrison situations.



Herbert W. McCarthy is Program Analyst in the Directorate for Food Service, Office of the Assistant Secretary of Defense (Installations and Logistics). Following five years military service and employment in private industry, he joined the Navy Department. He was Director of the Planning and Comptroller Department, U.S. Navy Finance Center, before assuming his present position in 1966. He has a B.S. degree in Business Administration from Boston College.

Early History of Military Food Service

In 1794, Congress saw the need for prescribing a different ration for the Navy from that which it has specified for the Army 19 years earlier. The Navy was given different items in consideration of the varied circumstances under which sailors would be fed. Also some thought was given to the necessity for preventing shipboard illnesses which were common among seafaring men at that time. Thus, the Military Services started along separate paths in developing food service programs for their members. This basic difference among the Services was continued when, in 1947, the Air Force became a separate Service but kept the Army ration. However, in reality, while the differences between the Services continued, the reasons for the differences began to disappear. As more sophisticated ships were built, the equipment designed for shipboard use became more comparable to the equipment found in land installations. Improvements in packaging and preservation methods made a wider variety of food available for use on board ships and on the ground. Technological improvements made it possible for military feeding to more closely resemble commercial feeding. Finally, the similarities between the Services became more apparent than any previous differences. Thus it was no surprise when, in 1966, the Logistics Management Institute recommended to the Secretary of Defense that he establish a focal point for food service matters within his office.

DOD Directorate for Food Service Created

Former Secretary McNamara established a Directorate for Food Service within the Office of the Assistant Secretary of Defense (Installations and Logistics) in July 1966. The mission assigned to the directorate was to develop a uniform food service program for all of the Military Services and to improve that program wherever technological changes made it possible. To insure a full knowledge of all current programs and to provide for participation by all Services in development of a single program, the directorate was staffed with one officer from each of the four Military Services and one civilian. Captain James A. Warren, USN, was appointed director and continues to serve in that capacity.

After the initial staffing was completed, joint Service task groups were formed to study all areas of food service and make recommendations for improvement and standardization among the Services. The task group efforts were completed in the summer of 1967, and their recommendations began to take on life almost immediately.

Single Allowance for All Services

While the task groups were at work, the directorate developed a uniform food allowance for enlisted members of all of the Military Services. Basically, this allows all servicemen the same daily monetary value of food regardless of their

parent Service. Thus the basic difference between the Services was overcome.

Uniform Food Service Program

The next step was to develop a set of standards and objectives for this new program. This gave birth to what is now known as the Department of Defense Uniform Food Service Program. Standards set forth in this program show that DOD has begun to make its program more comparable to that of private industry. The standards call for:

- Development and use of standard menus supported by standard recipes.
- Cafeteria-style feeding using salad bars, bulk beverage dispensers, a la carte breakfasts, and optional short-order meals, wherever practicable. The preferred dinnerware is either compartmented trays or plate service, whichever is more practical under local conditions.
- Dining facility decor consistent with that found in first-class commercial cafeterias.
- Food service personnel engaged in the preparation and serving of food to be neatly attired in appropriate food service uniform.
- Formal training in food service management and operations for food service management personnel and structured on-the-job training (OJT) for all personnel not receiving formal training, with OJT assistance to be provided by Food Management Teams.
- Common food service accounting and reporting procedures throughout DOD.

Food Planning Board

With these six standards set as the minimum requirements for military feeding, then came the problem of implementation. Starting with the basic item in the program—food—the Department of Defense Food Planning Board was established, chaired by the Director for Food Service. The board provides uniform recipes and menus for the Defense Department. Using the new Armed Forces Recipe Service, the board has spent the last six months testing a standard 42-day cycle menu at selected installations throughout the United States. All Services participated in the test and are currently evaulating the results.

Two committees have been established under the board. The Armed Forces Recipe Service Committee, headed by the Navy, has developed a single recipe service for use in all military feeding. This recipe service was published in February 1968. The committee retains responsibility for maintaining the recipe service and making changes to it. The Product Evaluation Committee, chaired by the Army, is responsible for the introduction of new products into the DOD Food Service Program.

Single Contact for New Products

Now there is one point of contact through which a product can be placed into the feeding program of all of the Military Services—the Armed Forces Product Evaluation Committee. This eliminates the need for vendors to contact each Service individually to introduce a new product. Food items brought into the program can be placed into recipes for use by all Services through the efforts of the Armed Forces Recipe Service Committee. Not only does this arrangement aid industry representatives seeking to present their products for DOD use, but suggestions from units in the field are also forwarded to the appropriate committee for action.

At this point it is well to note that the Surgeon General of the Army was assigned the responsibility for developing nutritional standards to be utilized by the DOD Food Planning Board in planning menus and recipes. The nutritional standards have been spelled out and are included in the menu just tested.

Facilities and Equipment

In conjunction with the establishment of a food planning board, it was also deemed appropriate to set up a joint Service board to develop standard designs for dining halls and other food service facilities, and to prepare a food service equipment catalog and operation manual. One function of the DOD Food Service Facility and Equipment Planning Board is to maintain liaison with industry food service research and development activities to insure that all modern food service technological advances are considered for incorporation in the DOD Food Service Program.

Contractual Food Service

As a part of the overall DOD effort to eliminate military personnel where

SERVING LINE in a typical military dining hall. The goal of military food service operations world-wide is nutritious and delicious, attractively prepared and served food. This dining hall is at Kelly AFB, Tex.

no military need exists, the Military Services have been directed to review all food service positions and determine those which meet certain specified requirements for military staffing. Those positions which do not meet these requirements are subject to civilian staffing either through direct hire (Civil Service employees) or by the use of contractor services.

In connection with the possible expansion of contractor-operated food service, current contract specifications and procedures are being reviewed with an eye toward attracting more food service contractors into active participation in the DOD Food Service Program.

Personnel Training

In spite of the increasing trend toward civilianization of the program, large numbers of military personnel will always be needed in food service. These personnel must be well trained, not only as cooks and bakers, but as food service managers. During the past year the Army and Air Force initiated use of Food Management Teams composed of senior food service specialists. Like the Navy and Marine Corps teams which have been active for several years, the Army and Air Force specialists visit activities to assist in on-the-job training, and to give advice and guidance to aid local personnel in improving food service at the local level.

In addition to the field efforts, the Military Services are jointly developing programs of instruction and curricula to provide for improved formal training in common areas of food service. Instruction peculiar to the needs of one Service will be carried out by the Service concerned.

Research and Development

Another area of interest is that of research and development as it relates to food items, packaging, equipment, systems, and related functions. The Department of the Army has been given this responsibility for the entire Defense Department. The Army has assigned this function to the U. S. Army Natick Laboratories at Natick, Mass.

Personnel at Natick Laboratories are now engaged in the development of a long-range research and development program in support of the DOD Food Service Program. This effort is two-pronged; it will treat both field and garrison feeding. There is no question that the broad experience of Natick Laboratories in support o earlier food programs will be a sul stantial asset to the overall improve ment effort. For example, a ne field feeding concept called SPEE is now in the field evaluation phas at Natick.

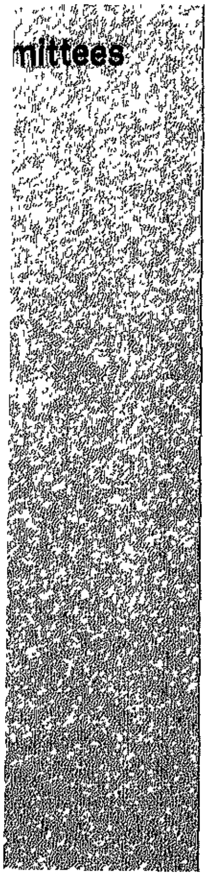
SPEED is an acronym for "Sub sistence Prepared by Electronic En ergy Diffusion," but more aptl applies to its basic purpose which to set up and feed a company-siz unit in a short period of tim Equipped with two microwave oven the unit can cook 100 pounds o roast beef in just one hour, compare with the conventional three and one half hours. An ovenload of bread ca be baked in 9 minutes, as opposed t 25 in a regular oven. The SPEE unit is completely self-contained i a 12-by-7-by-8-foot pod which can b carried in the bed of a 2½-to truck or towed on its own transporte wheels. For rapid delivery, the uni can be airlifted by helicopter. Th introduction of this type of unit int field feeding situations may be th answer to combat feeding problem of today.

Looking to the future we recogniz that improving the kitchen is no enough. Food items being served mus change, labor requirements must b held to a minimum, and technica skill requirements must be lowere in order to feed more people on world-wide basis. Private industr needs to become a partner in thi future planning.

Industry Participation

Support is currently being give to the DOD program by industria organizations such as the Nationa Restaurant Association, the Nationa Security Industrial Association, an the Research and Development As sociates. It is believed that throug a constant interchange of informatio the DOD Food Service Program wil keep abreast of technological an managerial improvements achieved by its commercial counterpart. On the other hand, industry, knowing the course which DOD intends to follow, will be able to provide a responsive base to support the program. Such common commercial items as convenience foods, improved packaging and preservation techniques, high-speed cooking equipment, and others will be introduced into military feeding as rapidly as practical.

Some of the areas currently being



spotlighted by industry task groups are:

- Contractual food service (National Restaurant Association).
- Joint Service recipes, food service equipment, a food service magazine, sanitizing procedures, automated food service, food service executive training, and a food service program of the future (National Security Industrial Association).
- Use of carcass versus boneless meats, review of specifications, stable compact foods, easy-open cans, flexible packaging, single-pack spices and seasonings, and food service systems (Research and Development Associates).

As the program continues, new task groups may be formed and others, having completed their assignments, will be dissolved. This DOD-private industry relationship is increasingly necessary in the ever changing food service field.

Future Development

Continual changes in the food service industry point the way to future food service operations. Increased automation of food service must be reckoned with in the military as well as in private industry. Increasing dependence upon electronic data processing equipment is just as true in the military as in civilian life. The Defense Department, long a leader in the use of EDP equipment, must eventually bring subsistence accounting and development of requirements into the EDP systems of the Military Services. Menu planning itself has already proven to be susceptible to computerization in some areas of institutional feeding. This concept is under serious consideration for DOD use in the not too distant future.

Military labor is no longer considered as a free commodity. Instead, labor-cost tradeoffs must be considered in the same way as private industry has been forced to consider them due to rising labor costs and a shrinking labor market.

Pre-formed and pre-cooked foods must be evaluated. This creates a new world of problems to be resolved, such as the design of specifications, storage requirements, and the total logistics system necessary to support their use. These are problems to be overcome—not avoided.

The DOD Food Service Program of the future must be carefully thought out and developed. The program must include not only static feeding situations, but also take into consideration field feeding on a worldwide basis—in hot and cold climates, under high and low humidity, on land, at sea, and in the air—in countries which bear little resemblance to the United States in terms of resources. This last consideration makes it clear that the military food service system must be a complete development, not only of food items but also of storage, transportation, and other equipment.

The problems confronting the DOD Food Service Program are similar to those faced by private industry—rising costs (already, food cost alone is approximately $1 billion annually), shrinking labor market, loss of skills, and an increasing demand for timely and round-the-clock services. Add to this the unique problems of combat, shipboard, in-flight, and under-water feeding, and the result is a challenge to all of our research and development capabilities.

The ultimate goal is to keep the U.S. serviceman well fed with an adequate diet of the food he likes to eat. Whether in the future he receives his food from a neatly attired cook or a sophisticated, automated system, or carries it in his pocket or on his back in a field or combat situation, this is the objective—and the challenge.

New Energy Absorber Boosts Runway Safety

The first aircraft arresting system developed for operational rather than emergency use is now saving pilots and planes at 14 sites in Southeast Asia. Known as BAK–13, the new arresting system is designed primarily for the F–4 aircraft and can be ready at a moment's notice—taking only 90 seconds to recycle. The system was developed by the Air Force System Command's Aeronautical Systems Division, Wright-Patterson AFB, Ohio.

Basically, the system consists of two identical energy absorbers positioned at opposite sides of the runway. An arresting cable spans the runway and is connected to the absorbers by giant nylon tapes which unwind from reels located atop each energy absorber.

The tape reel is keyed to a shaft which, in turn, is keyed to a vaned rotor or paddle wheel immersed in a coolant fluid. When an aircraft engages the cable it causes the tape to unwind, activating the water brake which absorbs the kinetic energy of the aircraft.

As the aircraft rolls down the runway, the submerged paddle wheel spins around in the solution. The resultant turbulence created in the tub brakes the speed of the aircraft. The kinetic energy then is converted to heat energy which is dissipated by a circulatory coolant system.

BAK–13 can stop aircraft traveling at 190 knots and weighing 50,000 pounds, such as a fully loaded F–4, or it can stop aircraft traveling 156 knots and weighing 80,000 pounds.

The simple and rugged construction of BAK–13 provides advantages from maintenance, logistic and operational standpoints. Components last longer and can withstand higher loads. Because of these features, it can be used much longer than previous arresting systems.

The system will eventually be used in conjunction with rapid air base construction.

Nuclear Explosion Simulator Operational at Kirtland AFB

The Air Force claims to have the world's two largest X-ray machines. They are part of a new facility at Kirtland AFB, N.M., established to study the effects of nuclear radiation on electronics.

The larger of the two X-ray machines weighs 450 tons and is 90 feet long. The smaller one weighs 130 tons and is 60 feet long.

Under the operational supervision of the Air Force Special Weapons Center, the huge X-rays produce brief pulses of intense radiation which simulate the gamma rays generated by a nuclear explosion. Electronic equipment to be tested is placed in a cell which is shielded by high density concrete walls five feet thick and massive lead doors weighing 94 tons each.

Tests in the facility will help the Air Force and industry design and build electronic equipment with increased resistance to radiation.

F–15 Engine Definition Contracts Awarded

The Air Force has obligated initial funding increments totaling $2.7 million for contract definition of engines for the F–15 fighter aircraft. Awards were made to Pratt and Whitney Aircraft Division of United Aircraft Corp. ($1.242 million), W. Palm Beach, Fla.; and to the Aircraft Engine Division of the General Electric Co. ($1.458 million), Evendale, Ohio.

Under separate initial engine development contracts awarded to these companies in August 1968, work is progressing on prototype engines from which the Air Force's F–15A and the Navy's F–14B engine versions will be developed.

These contracts, expected to total $3.834 million, will produce refined data integrated specifically with the F–15 airframes now in competitive development by Fairchild Hiller, McDonnell Douglas, and North American Rockwell. Final proposals for this aircraft will be based in part on these data.

DOD Asks $2.4 Billion for FY 1970 Military Construction

The Defense Department has submitted to the Congress a Military Construction Authorization Bill for FY 1970 totaling $2,474,014,000, requesting new authorization in support of the Military Services, the Defense Agencies, and the Reserve Components.

Projects for which authorization has been requested are located at 288 named military installations in the United States, and at overseas bases in the Caribbean, Europe, Pacific Islands, Japan and Korea.

The main objective of the proposed construction is to strengthen and improve the combat readiness and capabilities of military land, sea and air forces wherever they are stationed, and to provide them with the modern facilities required to support the advanced weapons and defensive systems with which they are equipped.

Included in the total authorization request is $694,418,000 for military family housing and $1,850,000 for homeowners assistance. Construction of new family housing units accounts for $108,332,000 of the total amount, with 4,800 units being planned for construction in the United States and overseas. The balance represents continuing requirements necessary for maintenance and operation, improvements to existing quarters, leasing costs, and payments of principal and interest on mortgage obligations.

Proposed Military Construction Authorization for FY 1970

	U. S. Locations	Overseas Locations	Locations Not Specified	Total
Army	$ 831,637,000	$127,706,000	$ —	$ 959,343,000
Navy	303,803,000	49,971,000	—	353,774,000
Air Force	297,916,000	54,213,000	—	352,129,000
Reserve Components	40,000,000	—	—	40,000,000
Defense Agencies	45,597,000	1,903,000	25,000,000	72,500,000
Subtotal	**$1,518,953,000**	**$233,798,000**	**$ 25,000,000**	**$1,777,746,000**
Military Family Housing	—	—	[illegible]	[illegible],000
Homeowners Assistance	—	—	[illegible]	[illegible]000
Total	**$1[illegible]**	**[illegible]0**	**[illegible]**	**[illegible]**

Stoppable Rotor Concept Subject of USAF Study

The Air Force is conducting a one-year computer study of stoppable rotor aircraft to develop analytical engineering methods in predicting stability and control during the conversion stage.

The study program is designed to reduce technical risks encountered when rotors are stopped and started, stowed and unstowed, and conventional flight is performed.

Two stoppable rotor concepts will be studied. The first concept is a horizontal stoppable rotor in which the stopped blades are folded at the same level that the rotors operate. The second is one that tilts the rotor forward, stops the blades, and folds them backward into a streamlined position.

Prediction methods will consider the rotor disk angle of attack, blade azimuth position, collective and cyclic blade pitch, effects of coupling between the body and rotor of the aircraft, blade dynamic and aeroelastic characteristics, and other effects.

The computer program is being developed by the Bell Aerospace Corp., Helicopter Div., Fort Worth, Tex., under the direction of the Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio. Robert Nicholson is the laboratory's project engineer.

Methods developed by the Bell Corp. are intended for use in preliminary design and evaluation of stoppable rotor aircraft concepts. Prediction methods will be used for aircraft conversions occurring between 115 and 230 miles an hour, at disk loadings up to 15 pounds a square foot, blade loadings up to 120 pounds a square foot, and aircraft gross weights up to 100,000 pounds. Methods will be developed for use over a broad range.

No tests will be conducted during the study, but test results and data obtained from related programs will be used to validate the prediction methods developed. Programs developed will be demonstrated on high-speed digital computers at the Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, Ohio.

Army Awards Study Contracts for New Rocket System

Contracts totaling more than $2.5 million in value have been awarded to five companies for development proposals on the Army's new Multiple Artillery Rocket System (MARS II) planned for the 1970s. MARS II will be the Army's first attempt to combine multiple launch and guidance capabilities in a rocket system.

Contract specifications call for each company to perform a six-month study. The Army will select a base line concept from these studies to proceed into a contract definition phase.

MARS II is intended to be a simple, rugged, reliable, low-cost tactical artillery rocket system. Considerable work on the system has already been conducted by Army laboratories. The program is now under the management of the MARS II Product Office at the Army Missile Command, Redstone Arsenal, Ala. Lieutenant Colonel Wayne B. Miller is the product manager.

Concept design study contracts went to: Chrysler Corp., Missiles Div., Warren, Mich.; LTV Aerospace Corp., Missiles & Space Div., Warren, Mich.; The Boeing Co., Space Div., Huntsville, Ala.; Northrop Corp., Nortronics-Huntsville, Ala.; and Martin-Marietta Corp., Orlando, Fla.

Second Source TOW Contract Awarded

The U.S. Army has awarded a $2.9 million contract to Chrysler Corp. Huntsville Space Operation as an alternate producer of the tube launched optically sighted wire guided (TOW) missile. Chrysler will initially produce only a few of the new anti-tank missiles. If those missiles qualify and are tested successfully, the Army has the option to buy more.

The Army ordered TOW into production last month by awarding a $55 million contract, the first increment of a $140 million package, to Hughes Aircraft Co., the prime contractor.

Chrysler was one of 63 contractors asked to submit proposals during second source competition. Selection was made by the Army Missile Command.

THE 40MM GRENADE LAUNCHER, attached to the underside of the M16A1 rifle, is prepared for firing by an infantryman. In combination with the rifle, the launcher gives the soldier a dual capacity of point and area fire.

Army Forms Small Arms Agency at Aberdeen, Md.

The Army Materiel Command has formed a new agency to study small arms weaponry in an effort to insure that American soldiers will always be armed with the best individual weapon systems available.

The new organization is called the U.S. Army Small Arms System Agency and is located at Aberdeen Proving Ground, Md.

Formation of the new agency came as a response to the Army's need for new and complete system approaches to individual weapons, including rifles, pistols, shotguns, grenade launchers, machine guns, associated ammunition, mounts and sights. The agency will perform as a management group, initially detailed from within the Army Materiel Command, rather than as an operational laboratory.

Responsibilities of the Small Arms System Agency will include determining the need for small arms weaponry, and the identification and exploitation of technological resources within the DOD structure and industry to meet these needs. The organization will also serve as a clearing house for ideas and designs for development of small arms weaponry for the infantryman of the 1970s.

Through control of technical and financial resources, the agency will integrate existing individual weapons capabilities of the Army Munitions Command, the Army Weapons Command, and the newly designated Army Research and Development Center, Aberdeen, Md.

The agency will have contractual authority, as well as authority to direct the integrated small arms systems effort of in-house agencies. It is foreseen that responsibility for an item will be retained by the agency, upon completion of development phases, through the first production phase.

Colonel Walter E. Rafert is Commanding Officer and Director of the Small Arms Systems Agency, with Leonard B. Ambrosini designated as Acting Technical Director.

Conversation Between Two Small Businessmen:

Snaring Government Contracts

Colonel John Bex, USAFR

Participants: Harry Faust, President
Consolidated Gadget Corp.

Bill Martin, Owner
United Widget Works

Place: In the office of Bill Martin.

Time: 10:00 a.m., Dec. 2, 1968.

Faust: What junk! Here's another article talking about opportunities for small businessmen to sell to the Defense Department. That stuff really burns me up.

Martin: Why?

Faust: Why? Because everybody knows it can't be done. The small business doesn't have a chance against the mammoth corporation. Read any newspaper. The big multi-million dollar contracts—where do they go?

Martin: To big multi-million dollar companies, right?

Faust: Right!

Martin: And that's all you ever hear about, right?

'aust: Right.

artin: So from our point of view as small businessmen, that's bad?

aust: You bet, that's bad!

'artin: Well, let me tell you a little secret. In a way that's good. I mean, it has a good side to it once you understand it and know how to take advantage of it.

'aust: What?

Iartin: Well, it is a fact that small business does get an opportunity to compete for the Defense Department contract spending, however small you may think it is. Contracts with small businesses don't make headline news but there are many of them, and they do exist. Congress, in fact, enacted legislation to insure that small business gets a fair share. You and I feel that this small business share should be larger. Now, so does Congress and the Administration generally. Special effort is being made continuously to increase the small business share of the defense dollar. The Small Business Administration, the Defense Department, and the two select committees for small business in the House of Representatives and the Senate are continually fighting for and protecting small business. That's the good side of the story, if you're one of the minority of small businessmen who understand this and know how to take advantage of it. Many of them still mistakenly believe it's hopeless, so they don't try. This reduces the competition and make it easier for those of us who do try.

Faust: Well, have you tried?

Martin: Yes—and succeeded. I just landed a defense contract last month.

Faust: No kidding!

Martin: No kidding. Now you know why I believe it's possible—because I've done it. Confidentially, it wasn't so hard—no more red tape than doing business with any other branch of our Government. This is just between ourselves, of course, because

Colonel John E. Bex, USAF Reserve, is a Special Project Officer in the Office of the Deputy for Small Business, Directorate of Procurement Policy, Deputy Chief of Staff (Systems and Logistics) at Hq. Air Force.

now when I hear some of the boys saying that doing business with bureaucrats is so impossible, sometimes I don't even bother to argue with them. Why should I? Their ignorance just increases my chances.

Faust: Okay, I'm with you there. I'm willing to become one of those like yourself who try and succeed. So what's the secret?

Martin: It's a big secret all right! It boils down to this: You find out what is required and then try to fulfill the requirements—the secret of successful business anywhere. It's an open secret. In fact, it's all spelled out in several government publications. But then an open secret is often the best kind. I mean, if you don't read the publications, then what's in them is a secret to you. Right?

Faust: Right.

Martin: And that's not all. There are officials, hundreds of them in fact, whose full-time job is helping small businesses in getting their share of government business. They are called small business specialists by the Army, Navy, Air Force and the Defense Supply Agency, and procurement center representatives by the Small Business Administration. But if you don't talk to them, then how can they help you?

Faust: Okay. Go on with the story. How does the thing work, and how do I get started?

Martin: Well, as you may know, the Defense Department buys, or procures as they say it, a lot of things through a formally advertised bidding process. It solicits bids for certain items from suppliers or contractors who are on its lists in the various categories. The invitation for bid includes a detailed description including drawings, with government specifications of what is wanted

Faust: So I'd be smart to get on the Defense Department lists for the things I'm interested in?

Martin: Right. You inform the purchasing office concerned that you want to bid on certain items and supply the purchasing office certain information about your ability to carry out defense contracts. When you count all three Services—Army, Navy and Air Force—and the Defense Supply Agency, they operate approximately 525 offices throughout the country. Go to the nearest one. That office can give you information on all its local needs and may have information on the needs of the other offices. The Defense Department is big and is organized to do a good job. The facts about your ability are put on a Standard Form 129, the Bidders Mailing List Application, and its supplement. When the application is completed, you send it to each purchasing office where you have an interest. In the case of certain products, the invitation for bid may specify that the item to be purchased is on a Qualified Products List, a QPL item.

Faust: Qualified products, eh? Sounds like the Government is getting to be a smarter buyer.

Martin: A whole lot smarter than in some of the old days you may have heard about. But, remember, its our taxpayer dollars they're spending. Whose De fense Department is it?

Faust: Oh sure, that's fine with me. I really prefer t do business with someone who is business-lik Some of the things I've heard, like some of thos percent of cost contracts, where the more mone you waste the more you make, burn me up. N businessman in his right mind would ever think o agreeing to such a thing.

Martin: You will be glad to know that such contracts don' exist anymore. Those cost-plus a percentage o cost contracts are now prohibited by law. Als this filing of qualifications for undertaking con tracts, and the like, helps the small business a well as the Defense Department.

Faust: How so?

Martin: Well, it helps to protect the small business fron making totally unrealistic bids on contracts whicl it might not be able to carry out, or could fulfil only at a considerable loss to the firm. After all an accepted bid or award becomes a formal con tract but a bad, unsound contract is generally a unpleasant problem for all concerned—Defense Department and business firm. Of course, not al products or services are purchased through the bidding system. Some things are purchase through a technique called negotiations which still means that there is free and open competition. But even here, all procurement offices make us of their bidders lists.

Faust: I see that I should apply to be put on the proper lists, all right! But how do I find out more about the lists? How can I get even a general idea o who is buying what to begin with?

Martin: Well, you can get an excellent overall picture from this pamphlet right here on my desk. It's called "Selling to the Military" and is published by the Defense Department. It has extensive lists of military purchasing offices, and details the items purchased by Defense Agency or Military Service. In fact, it pretty well lives up to its intent "to provide business firms, which have little or no experience in selling their products or services to the Department of Defense, with basic steps and initial contacts for locating sales opportunities." Oh sure, there is a lot of other literature, too, which you can pick up at any one of the 81 Small Business Administration offices in the country or order from them. In fact, many different procurement offices at the various military installations have issued brochures on the very subjects we're talking about. But this pamphlet is about as good a source to start with as any. It contains a pretty thorough discussion of how to do business with the Defense Department.

Faust: What about day-to-day needs, and defense contracts and bids, etc.? Do I have to chase this down through a lot of newspapers in different parts of the country, or in publications of the various Services?

rtin: Definitely not! There is a special publication which takes care of that called the *Commerce Business Daily*—the *Wall Street Journal* for knowing about government business. It will keep you posted as to the action. It carries Defense Department proposed procurements estimated to exceed $10,000, and civilian agency procurements expected to exceed $5,000. You can refer to it in any military procurement office or local Small Business Administration office. A year's subscription costs only $15. Just send your check and name and address to the Superintendent of Documents, *Commerce Business Daily*, Government Printing Office, Washington, D. C. 20402. It maintains a very comprehensive coverage, including a daily list of U. S. Government invitations to bid, subcontracting leads, contract awards, sales of surplus property, and foreign business opportunities.

ust: Say, that's an interesting angle right there—information about subcontracting leads.

rtin: It certainly is. For many small businesses like ours, subcontracting may be as rich a source of business opportunity as prime contracting can be. At least, I know in my case I first started out with what turned out to be some excellent subcontracts, and I always have my eyes open for new leads.

ust: I begin to see how I can get started in the game if that's all you need. And I guess I can manage as much political influence as you have, and you have already scored.

rtin: That's not hard, since I don't have any such influence at all. All joking aside, you'll find the whole affair more routine and business-like than you may have imagined. Contracting officers, as purchasing agents are called nowadays, are mainly interested in making a good business deal—just as you and I.

ust: I'd think so, considering whose money they are spending!

artin: Come to think of it, I've hardly mentioned yet the most important source of information and aid.

aust: What's that?

artin: People. I mean the various persons whose job it is to assist you in doing business with the Government. Many of them, like the officials of the Small Business Administration, focus exclusively on the needs and problems of the small businessman. It's their full-time job. They're experts at it and without exception are willing and eager to fill you in on any aspect you're interested in. Mr. Taxpayer, you're paying for it all so you might as well make use of some of those fine services offered. You don't have to go down to Washington to get counsel and help since, as I said, there is a local Defense Department Small Business Advisor Office at the Army Depot near here which may, in any case, be better acquainted with local needs and opportunities.

aust: What about the procurement offices of the government agencies and Military Services themselves, local or otherwise?

Martin: Obviously, it is very worthwhile to get acquainted and talk with those people since they are the number one source of information on procurement of defense requirements. In fact, they're usually delighted to talk with you because it is their business to improve and enlarge their lists of good suppliers. You may be just the man to provide a new element of healthy competition in a situation where the Defense Department has been seeking additional suppliers. Let's not forget requirements of the military and opportunities to do business with the Defense Department are constantly changing, so you've got to keep in contact in one way or another to stay ahead or be current.

Faust: Well, it's encouraging to know that the cards aren't stacked against me from the start. A small business today has enough problems with financing, cash flow, and the like, as it is.

Martin: Far from it. In fact, the cards have in some instances, in a very real sense, been stacked in your favor. Congress and the Executive Branch, through the Small Business Administration and the Defense Department, have made several deliberate moves in this direction. Ever hear of "set-aside procurements?"

Faust: No, what are they?

Martin: Well, all defense procurement activity is clearly spelled out in a "Bible" called ASPR, the Armed Services Procurement Regulation. This regulation states that on all contracts of $2,500 or more, procurement contracting officers should give consideration to all or part of a procurement being set aside for exclusive awarding on a competitive basis to small business concerns. Many such "set-aside" purchase opportunities for small businesses are listed in the *Commerce Business Daily.*

Faust: Okay. I get the picture. I can see I don't need to feel like David facing Goliath in going out after a defense contract. But frankly, why does the Government go to this trouble to aid and even favor the small businesses?

Martin: I think it's simply sound economics for one thing. The value of the small business concern to the general well being of this country's economy was recognized by the Congress to such an extent that it deemed it appropriate to establish, under law, organizations and policies which could protect small businesses throughout the country.

Faust: I read in the *Wall Street Journal* the other day that the country's 5 million small businesses will produce 40 percent of our $800 billion Gross National Product this year. Big business could not exist without the small business. So I guess we're important for the Government to look after.

Martin: The President says, "Small business is big business."

Status of Funds Report

Outlays

July-October, Fiscal Year 1969

(Thousands of Dollars)

	Outlays					Unpaid obligations	
	Jul 1968	Aug 1968	Sep 1968	Oct 1968	Cum thru 31 Oct 1968	At start of year	As of 31 Oct 1968
	1,494,806	1,666,853	1,721,041	1,767,306	6,650,006	761,917	1,079,415
	103,168	114,825	77,516	75,132	370,641	149,746	124,618
	188,789	193,197	195,990	197,931	775,907	6,880	6,298
	6,986	−50,791	45,935	−12,066	−9,936	—	9,936
	1,793,748	1,924,085	2,040,483	2,028,302	7,786,618	918,548	1,220,267
	1,443,402	1,807,548	1,855,893	1,696,547	6,803,385	4,033,198	5,256,353
	784,563	778,362	791,947	784,237	3,139,099	9,591,226	8,686,683
	138,900	203,163	172,604	225,963	740,630	2,069,736	2,603,625
	142,710	142,298	150,859	183,744	619,611	3,447,418	3,478,122
	24,486	30,213	31,898	46,495	133,092	610,190	591,165
ipment	47,079	599,159	465,391	514,536	1,626,165	6,595,367	8,550,115
	76,376	108,381	145,352	133,244	463,353	1,881,334	1,707,228
	94,731	164,114	193,608	189,198	641,651	2,056,183	2,059,818
	318,548	27,211	−7,228	3,164	341,690	−7,225	−348,363
	1,627,380	2,052,898	1,944,433	2,080,577	7,705,288	26,244,228	27,278,379
ation							
	73,628	85,159	80,085	77,712	316,584	777,774	758,367
	81,834	22,459	76,223	88,030	268,546	717,451	745,832
	172,188	199,987	152,848	225,163	750,181	983,018	1,581,506
	113,919	111,529	104,178	101,841	431,467	487,480	577,410
	23,880	23,686	25,670	28,639	101,825	245,279	336,201
ipment	18,524	25,128	22,183	29,182	95,017	216,577	289,768
	54,544	59,729	57,242	71,803	243,318	478,981	547,099
pport	42,829	70,776	65,451	38,377	216,933	189,338	201,477
	4,444	−28,496	16,642	−7,620	−15,030	−1,633	10,588
st, & Eval.	585,241	569,957	600,515	653,128	2,408,841	4,094,265	5,047,810
	62,086	100,649	117,040	139,414	419,189	1,784,255	1,884,082
	39,866	32,516	45,027	45,928	163,337	174,687	236,257
	5,459	9,299	7,011	7,040	28,809	80,629	66,872
am	172	8	57	272	509	1,071	611
	−72,553	−62,277	−163,576	94,272	−204,134	6,078,411	6,830,774
ral Funds	5,484,801	6,434,677	6,446,883	6,745,481	25,111,842	43,409,287	47,821,405
	59,831	34,200	47,503	56,461	197,995	1,823,034	1,713,616
	5,544,632	6,468,877	6,494,386	6,801,942	25,309,837	45,232,322	49,535,021
ncept adj.	−9,189	−2,386	−15,956	−7,922	−35,453	8,794	1,922
pt adj.	74,899	35,466	5,294	22,149	137,808	433,454	287,496
stments	65,710	33,080	−10,662	14,227	102,355	442,248	289,418
nse	5,610,342	6,501,957	6,483,724	6,816,169	25,412,192	45,674,570	49,824,439

	527,967	695,272	701,390	719,582	2,644,211	382,077	583,781
	75,378	79,140	53,028	49,893	257,434	112,578	83,286
	−12,297	−47,087	−15,779	30,105	−45,058	—	45,058
	591,048	727,325	738,639	799,580	2,856,587	494,654	712,125
	502,285	713,947	642,095	695,306	2,553,643	1,541,708	1,706,016
	67,740	93,251	95,712	92,318	349,021	1,343,518	1,310,078
	18,182	52,414	42,981	52,328	165,905	629,712	958,663
	22,050	32,151	30,752	37,744	122,697	586,046	568,098
ipment	−170,833	377,356	304,330	193,574	704,427	3,445,481	4,551,820
	−17,933	28,137	69,468	53,808	133,475	688,774	653,044
	3,221	47,394	57,792	49,204	157,611	769,510	696,637
	367,630	−4,672	−19,990	12,681	355,649	−7,225	−362,385
	290,056	626,032	581,040	491,657	1,988,785	7,455,816	8,975,904
uation							
	6,868	9,987	11,076	10,897	38,828	98,272	110,684
	8,619	13,554	5,780	8,128	36,081	78,199	87,130
	37,426	62,111	48,583	56,178	204,298	386,366	568,838
	983	429	766	908	3,086	7,865	6,595
ipment	11,056	12,962	12,464	14,977	51,469	110,532	185,271
	24,895	26,364	24,897	29,960	106,116	196,748	209,780
port	6,954	7,164	8,002	8,581	30,701	88,898	40,932
	14,161	−3,779	11,244	−2,095	19,531	−1,633	−23,978
t, & Eval.	110,912	128,792	122,811	127,030	489,545	910,247	1,185,257
	19,914	35,188	36,398	45,363	136,858	768,046	783,319
	78,982	−29,058	17,082	6,093	73,099	1,955,905	1,816,863
	1,593,142	2,202,221	2,188,065	2,165,089	8,098,517	13,126,377	14,529,482
	−2,888	6,395	−10,532	−5,545	−12,570	10	−101
my	1,590,254	2,208,616	2,127,533	2,159,544	8,085,947	13,126,387	14,529,381

artment of the Navy

artment of the Navy	Outlays					Unpaid obligations	
	Jul 1968	Aug 1968	Sep 1968	Oct 1968	Cum thru 31 Oct 1968	At start of year	As of 31 Oct 1968
ary Personnel							
ctive forces	476,994	442,348	506,925	522,167	1,948,434	225,093	287,772
eserve forces	13,760	16,181	12,851	12,281	55,073	22,898	26,181
Jndistributed	−1,927	8,780	44,091	−45,758	5,186	—	−5,185
Total—Military Personnel	488,827	467,309	563,867	488,690	2,008,693	247,991	308,767
ation and Maintenance	354,321	448,899	583,130	321,465	1,707,815	1,466,352	1,967,290
urement							
Aircraft	260,523	241,987	205,684	235,593	943,787	3,218,049	2,825,659
Missiles	22,954	41,580	38,725	43,149	146,358	547,934	780,518
Ships	142,710	142,298	150,859	183,744	619,611	3,447,418	3,478,123
Tracked combat vehicles	2,436	−1,938	1,146	8,751	10,395	24,144	23,058
Ordnance, vehicles, and related equipment	101,588	107,632	109,758	180,882	499,860	1,718,994	1,815,163
Electronics and communications	46,187	54,603	32,550	42,999	176,339	645,301	588,129
Other procurement	13,181	73,979	82,489	119,095	288,744	1,143,225	1,253,862
Undistributed	−6,857	−696	14,085	−9,942	−3,410	—	3,410
Total—Procurement	582,728	659,394	635,246	804,270	2,681,633	10,740,005	10,767,939
arch, Development, Test, and Evaluation							
Military sciences	14,216	15,124	16,463	17,152	62,955	121,458	153,843
Aircraft	25,238	25,009	26,435	37,724	114,406	257,524	278,363
Missiles	71,978	63,975	48,802	57,944	242,699	258,025	470,621
Astronautics	1,290	1,578	1,965	1,416	6,249	16,269	20,649
Ships	23,330	23,086	25,670	28,639	101,825	245,270	335,201
Ordnance, vehicles, and related equipment	7,468	12,166	9,719	14,205	43,558	106,045	154,497
Other equipment	9,359	8,069	10,152	10,785	38,365	79,604	110,761
Program-wide management and support	15,586	34,304	34,986	8,978	93,854	133,064	117,483
Undistributed	536	−620	2,597	−2,983	−470	—	470
Total—Research, Develop., Test, & Eval.	169,501	183,292	176,788	173,860	703,441	1,217,258	1,047,891
ary Construction	15,852	31,180	37,664	46,633	131,329	573,575	677,743
lving and Management Funds	−42,795	57,412	−133,170	124,003	5,450	2,209,078	2,249,200
y—Federal Funds	1,568,429	1,847,486	1,863,525	1,958,921	7,238,361	16,514,258	17,618,891
y—Budget Concept adjustments	−3,260	−5,769	−4,882	895	−13,016	110	337
Total—Department of the Navy	1,565,169	1,841,717	1,858,643	1,959,816	7,225,345	16,514,368	17,619,218

artment of the Air Force

tary Personnel							
Active forces	489,845	529,233	512,726	525,557	2,057,361	164,747	207,862
Reserve forces	14,035	19,504	11,637	12,958	58,134	14,270	15,151
Undistributed	21,210	−12,484	17,623	3,587	29,936	—	−29,936
Total—Military Personnel	525,090	536,253	541,986	542,102	2,145,431	169,017	193,077
ation and Maintenance	493,743	551,087	545,020	593,123	2,182,973	927,881	1,457,073
urement							
Aircraft	456,290	443,124	490,601	456,326	1,846,341	5,029,659	4,500,946
Missiles	97,764	109,219	90,898	130,436	428,307	892,089	804,444
Ordnance, vehicles, and related equipment	116,321	113,170	51,030	139,449	419,970	1,484,836	2,182,627
Electronics and communications	47,889	23,525	42,869	36,005	150,288	589,008	460,180
Other procurement	75,897	39,614	51,100	19,632	186,243	100,001	66,053
Undistributed	−42,958	33,081	−1,175	297	−10,755	—	10,763
Total—Procurement	751,204	761,732	725,323	782,193	3,020,452	7,995,592	8,084,934
arch, Development, Test, & Evaluation							
Military sciences	11,875	14,982	12,763	12,971	52,591	104,162	110,309
Aircraft	47,977	−16,104	44,008	42,178	118,059	381,728	380,331
Missiles	62,784	73,901	55,458	111,046	303,189	888,627	636,107
Astronautics	111,696	109,522	101,447	99,517	422,182	463,856	550,161
Other equipment	20,290	25,296	22,193	31,058	98,837	202,629	226,551
Program-wide management and support	19,789	29,808	22,463	20,818	92,878	22,876	43,068
Undistributed	−10,253	−24,097	2,801	−2,542	−34,091	—	34,091
Total—Research, Develop., Test, & Eval.	264,159	212,807	261,133	315,046	1,053,145	1,512,878	1,880,636
ary Construction	25,582	33,800	42,587	46,213	148,182	425,858	407,301
lving and Management Funds	−36,524	−40,728	−17,813	−51,324	−146,389	621,170	1,603,321
Force—Federal Funds	2,023,254	2,054,951	2,098,236	2,227,353	8,403,794	11,552,896	13,626,354
Force—Budget Concept adjustments	−3,039	−3,012	−756	−3,055	−9,862	8,675	1,631
Total—Department of the Air Force	2,020,215	2,051,939	2,097,480	2,224,298	8,393,932	11,561,071	13,528,494

Defense Agencies/Office of the Secretary of Defense	Outlays					Unpaid obligations	
	Jul 1968	Aug 1968	Sep 1968	Oct 1968	Cum thru 31 Oct 1968	At start of year	As o 31 Oct
Military Personnel							
Retired Pay	188,789	193,197	195,990	197,931	775,907	6,880	6,
Operation and Maintenance	93,104	93,609	85,648	86,593	858,964	97,258	125,
Procurement							
Ordnance, vehicles, and related equipment	3	1,001	273	631	1,908	1,117	4
Electronics and communications	233	2,116	470	432	3,251	8,251	5,
Other procurement	2,432	3,127	2,227	1,267	9,053	43,447	43,8
Undistributed	728	−502	−148	128	206	—	−2
Total—Procurement	3,396	5,742	2,822	2,457	14,417	52,815	49,6
Research, Development, Test, & Evaluation							
Military sciences	40,669	45,066	39,783	37,192	162,710	453,882	381,0
Military Construction	738	486	391	1,205	2,820	16,777	15,7
Family Housing	39,866	32,516	45,027	45,928	163,337	174,687	236,2
Other—Special Foreign Currency Program	172	8	57	272	509	1,071	6
Revolving and Management Funds	−72,216	−49,902	−29,675	15,500	−136,293	1,392,258	1,200,8
Defense Agencies—Federal Funds	294,518	320,722	340,043	387,078	1,342,361	2,135,628	2,079,3
Defense Agencies—Budget Concept adjustments	−2	—	214	−217	−5	—	
Total—Defense Agencies	294,516	320,722	340,257	386,861	1,342,356	2,135,620	2,079,3
Office of Civil Defense							
Civil Defense	5,459	9,299	7,011	7,040	28,809	80,629	66,87
Revolving and Management Funds	—	—	—		—	—	
Total—Office of Civil Defense-Fed. Funds	5,459	9,299	7,011	7,040	28,809	80,629	66,07
Military Assistance							
Military Personnel	16	40	11	28	95	358	2
Operation and Maintenance	19,863	18,438	21,497	18,606	78,404	230,840	226,98
Procurement							
Aircraft	14,132	7,642	8,246	8,128	38,148	226,880	208,11
Missiles	−1,086	648	578	1,271	1,456	16,035	15,69
Ships	9	17	1,640	2,678	4,344	43,984	84,38
Ordnance, vehicles, and related equipment	8,643	1,534	17,707	10,146	38,030	192,738	187,90
Electronics and communications	14,666	670	5,552	4,330	25,218	101,235	94,06
Other procurement	7,128	2,226	2,789	3,786	15,938	88,420	91,81
Total—Procurement	43,542	12,732	31,521	30,334	118,129	669,292	682,05
Research, Development, Test, & Evaluation	—	—	—	10	10	35	4
Military Construction	837	−136	142	23	866	6,809	6,05
Revolving Fund	17,201	5,494	−4,020	3,726	22,401	848,233	797,87
Undistributed	−21,627	−2,867	−1,650	3,736	−21,908	67,472	30
Subtotal—Military Assistance	59,831	34,200	47,503	56,461	197,995	1,823,034	1,718,61
Total—Military Assistance-Bud. Concept adjustments	74,899	35,466	5,294	22,149	137,808	433,454	287,49
Total—Military Assistance	134,730	69,666	52,797	78,610	335,803	2,256,488	2,001,11

Obligations

Department of Defense	Available for Obligation	Obligations					Unobligated balance 31 Oct 196
		July 1968	Aug 1968	Sep 1968	Oct 1968	Cum thru 31 Oct 1968	
Military Personnel							
Active forces	19,582,892	1,787,704	1,747,114	1,750,888	1,768,187	7,053,893	12,529,40
Reserve forces	909,750	121,495	90,129	63,733	65,407	340,704	568,98
Retired pay	2,275,000	188,424	193,380	195,417	197,876	775,097	1,499,90
Total—Military Personnel	22,767,642	2,097,622	2,030,622	2,009,540	2,031,471	8,169,255	14,598,387
Operation and Maintenance	23,524,178	2,278,622	1,990,548	2,240,472	2,308,955	8,818,597	14,710,58
Procurement							
Aircraft	11,440,784	256,542	509,403	1,077,980	534,958	2,378,283	9,062,501
Missiles	4,153,282	433,808	117,880	520,471	238,553	1,319,712	2,833,570
Ships	8,800,643	279,852	109,358	146,304	146,793	682,307	8,118,336
Tracked combat vehicles	590,714	5,083	3,496	72,131	52,774	133,484	397,230
Ordnance, vehicles and related equipment	10,948,327	228,965	1,706,148	1,417,459	1,002,203	4,354,775	6,593,55
Electronics and communications	2,296,494	81,877	145,904	80,555	108,693	366,529	1,929,96
Other procurement	3,401,881	222,937	158,372	211,522	191,121	783,952	2,617,879
Undistributed	−2,014,720	—	—	—	—	—	−2,014,720
Total—Procurement	34,556,855	1,458,561	2,750,565	3,534,879	2,275,033	10,019,043	24,537,812
Research, Development, Test, & Evaluation							
Military sciences	1,135,347	64,618	88,662	99,637	71,490	324,411	810,936
Aircraft	908,689	56,940	158,647	95,984	−9,280	297,291	611,308
Missiles	2,339,913	585,302	240,952	360,246	248,576	1,385,076	954,837
Astronautics	1,296,839	197,905	68,839	98,448	181,883	547,075	749,764
Ships	250,958	118,868	86,707	25,309	21,897	107,781	63,177
Ordnance, vehicles, and related equipment	344,752	28,925	87,688	32,018	20,036	168,667	176,085
Other equipment	961,490	66,874	88,479	91,058	70,070	316,418	645,009
Program-wide management and support	626,772	77,259	85,114	82,558	69,682	314,608	312,184
Emergency Fund	—	—	—	—	—	—	
Undistributed	1,419,391	—	—	—	—	—	1
Total—Research, Develop., Test & Eval.	9,284,150	1,141,685	850,090	885,251	674,363	3,551,389	
Military Construction	3,858,564	138,756	142,188	202,642	173,972	657,558	
Family Housing	780,475	53,081	48,201	71,224	60,655	228,161	
Civil Defense	69,206	3,368	5,142	4,007	3,391		
Other	71,974	56	9	4	−20		
Subtotal—Military Functions	94,863,045	7,166,751	7,812,365	8,948,019	7,527,826	31	
Military Assistance	386,001	71,645	8,894	23,491	12,499		
Total—Department of Defense	95,249,046	7,238,396	7,821,258	8,971,510	7,540,327		

Department of the Army	Available for Obligation	Obligations: July 1968	Aug 1968	Sep 1968	Oct 1968	Cum thru 31 Oct 1968	Unobligated balance 31 Oct 1968
Military Personnel							
Active forces	8,103,600	735,831	733,217	712,351	719,484	2,900,883	5,202,717
Reserve forces	593,600	87,019	58,714	33,894	45,921	225,548	368,052
Total—Military Personnel	8,697,200	822,850	791,931	746,845	765,405	3,126,431	5,570,769
Operation and Maintenance	8,904,633	969,854	681,613	661,316	803,769	3,116,552	5,788,081
Procurement							
Aircraft	1,146,592	15,265	208,279	65,342	35,215	324,101	822,491
Missiles	1,018,855	69,424	45,871	344,702	62,900	522,397	496,458
Tracked combat vehicles	500,998	5,114	3,384	65,759	49,918	124,175	376,823
Ordnance, vehicles and related equipment	6,776,730	156,846	851,322	1,053,965	518,346	2,579,479	4,197,251
Electronics and communications	993,050	5,748	80,268	28,565	31,074	145,650	847,400
Other procurement	894,699	19,294	14,581	40,883	38,047	112,805	781,894
Undistributed	−2,082,863	—	—	—	—	—	−2,082,863
Total—Procurement	9,248,061	270,686	1,203,205	1,599,216	735,500	3,808,607	5,439,453
Research, Development, Test, & Evaluation							
Military sciences	204,911	24,178	17,365	13,155	15,618	70,316	134,595
Aircraft	149,892	13,290	16,085	6,696	9,103	45,174	104,718
Missiles	734,496	86,835	57,948	209,061	35,770	389,609	344,887
Astronautics	12,218	152	421	613	609	1,795	10,423
Ordnance, vehicles and related equipment	209,856	27,584	24,493	13,294	11,261	76,632	133,224
Other equipment	468,951	37,551	34,820	20,988	27,708	121,067	347,884
Program-wide management and support	102,150	19,075	7,677	5,990	5,770	38,512	63,638
Undistributed	45,078	—	—	—	—	—	45,078
Total—Research, Develop., Test & Eval.	1,927,547	208,666	158,804	269,797	105,839	743,105	1,184,442
Military Construction	1,862,009	32,920	65,816	81,602	52,169	232,507	1,629,501
Total—Department of the Army	30,639,450	2,304,975	2,900,769	3,358,776	2,462,682	11,027,202	19,612,247

Department of the Navy

Military Personnel							
Active forces	5,761,500	517,273	484,340	511,039	515,018	2,027,670	3,733,83
Reserve forces	156,220	17,859	12,330	16,549	9,294	56,032	100,18
Total—Military Personnel	5,917,720	535,132	496,670	527,588	524,312	2,083,702	3,834,01
Operation and Maintenance	6,323,095	369,964	600,950	587,710	889,144	2,447,768	3,875,33
Procurement							
Aircraft	3,546,602	8,541	91,190	168,460	296,795	559,986	2,986,61
Missiles	1,061,285	265,299	24,240	83,302	15,418	388,259	673,02
Ships	3,800,643	279,852	109,358	146,364	146,733	682,307	3,118,33
Tracked combat vehicles	29,716	−81	112	6,872	2,856	9,309	20,40
Ordnance, vehicles and related equipment	2,193,152	39,727	85,463	183,563	297,506	606,259	1,586,89
Electronics and communications	779,492	10,962	28,932	30,589	57,932	128,415	656,07
Other procurement	1,938,754	151,590	102,026	113,177	139,009	505,802	1,432,75
Undistributed	−385,426	—	—	—	—	—	−385,42
Total—Procurement	12,964,216	755,040	436,821	726,826	956,250	2,875,337	10,088,87
Research, Development, Test, & Evaluation							
Military sciences	116,765	21,140	29,075	30,596	16,031	96,842	19,9
Aircraft	220,015	1,576	112,358	5,308	16,064	135,306	84,7
Missiles	549,548	282,806	55,365	89,848	41,049	469,068	80,4
Astronautics	16,699	1,968	4,401	502	3,806	10,677	6,0
Ships	250,958	113,868	36,707	25,309	21,897	197,781	53,1
Ordnance, vehicles and related equipment	134,896	1,341	63,195	18,724	8,775	92,035	42,8
Other equipment	101,701	12,719	17,959	23,649	15,871	70,198	31,5
Program-wide management and support	242,055	11,996	53,255	50,137	42,117	157,504	84,5
Undistributed	1,289,478	—	—	—	—	—	1,289,4
Total—Research, Develop., Test & Eval.	2,922,110	447,413	372,315	244,073	165,610	1,229,411	1,692,
Military Construction	1,304,531	49,150	66,162	87,426	90,006	292,744	1,011,
Total—Department of the Navy	29,431,671	2,157,588	1,972,419	2,173,623	2,625,322	8,928,952	20,502,

ɔartment of the Air Force	Available for Obligation	Obligations					Unobligated balance 31 Oct 1968
		July 1968	Aug 1968	Sep 1968	Oct 1968	Cum thru 31 Oct 1968	
tary Personnel							
Active forces	5,717,792	534,600	530,157	526,398	533,685	2,124,840	3,592,952
Reserve forces	159,930	16,617	19,085	13,290	10,192	59,184	100,746
Total—Military Personnel	5,877,722	551,216	549,243	539,688	543,878	2,184,025	3,693,697
ation and Maintenance	7,165,247	822,997	612,069	901,765	511,528	2,848,359	4,316,889
urement							
Aircraft	6,747,590	232,736	209,934	848,578	202,948	1,494,196	5,253,394
Missiles	2,073,142	99,082	48,272	101,467	160,235	409,056	1,664,086
Ships	—	—	—	—	—	—	—
Ordnance, vehicles and related equipment	1,975,471	33,326	768,674	179,920	185,935	1,167,755	807,716
Electronics and communications	513,949	14,401	41,488	21,056	19,563	96,508	417,441
Other procurement	476,888	51,077	39,976	48,862	12,380	152,295	324,593
Undistributed	428,971	—	—	—	—	—	428,971
Total—Procurement	12,216,013	430,622	1,108,245	1,199,881	581,064	3,319,812	8,896,202
arch, Development, Test, & Evaluation							
Military sciences	195,209	9,028	13,336	27,533	13,437	63,334	131,875
Aircraft	538,782	42,074	25,204	83,980	−34,447	116,811	421,971
Missiles	1,055,869	165,661	127,644	61,337	171,757	526,399	529,470
Astronautics	1,267,922	195,785	64,017	97,333	177,468	534,603	733,319
Other equipment	390,838	16,604	35,700	46,421	26,491	125,216	265,622
Program-wide management and support	282,567	46,189	24,182	26,426	21,795	118,592	163,975
Undistributed	84,845	—	—	—	—	—	84,845
Total—Research, Develop., Test & Eval.	3,816,032	475,342	290,082	343,029	376,500	1,484,953	2,331,079
ary Construction	573,835	55,692	9,475	33,578	31,806	130,552	443,283
Total—Department of the Air Force	29,648,851	2,335,869	2,569,114	3,017,942	2,044,775	9,967,700	19,681,150

ense Agencies/Office of the Secretary of Defense

ary Personnel							
Retired Pay	2,275,000	188,424	193,379	195,418	197,876	775,097	1,499,903
ation and Maintenance	1,131,202	110,818	95,916	89,680	104,515	400,929	730,273
rement							
rdnance, vehicles and related equipment	2,974	66	789	11	416	1,282	1,692
lectronics and communications	10,003	271	216	345	124	956	9,047
ther procurement	90,990	976	1,789	8,600	1,685	13,050	77,940
Undistributed	24,598	—	—	—	—	—	24,598
Total—Procurement	128,565	1,313	2,794	8,956	2,224	15,287	113,278
rch, Development, Test, & Evaluation							
Military sciences	618,462	10,267	28,886	28,353	26,413	93,919	524,542
Emergency Fund	—	—	—	—	—	—	—
Undistributed	—	—	—	—	—	—	—
Total—Research, Develop., Test & Eval.	618,462	10,267	28,886	28,353	26,413	93,919	524,542
ary Construction	118,190	993	735	36	−9	1,755	116,434
y Housing	780,475	53,081	43,201	71,224	60,655	228,161	502,315
	71,974	56	9	4	−20	49	71,925
Total—Defense Agencies-OSD	5,073,868	364,952	361,920	393,670	391,656	1,515,198	3,550,670

ce of Civil Defense

Defense	69,206	3,368	5,142	4,007	3,391	15,908	53,298

tary Assistance

ry Personnel	78	15	37	—	26	78	—
tion and Maintenance	344,492	34,388	12,782	18,265	9,788	75,178	269,319
rement							
ircraft	11,035	−38,408	46,294	2,054	1,095	11,035	—
lissiles	1,351	−808	1,648	755	−282	1,308	43
ips	1,725	1,670	11	−119	112	1,674	51
rdnance, vehicles and related equipment	14,988	10,349	1,276	704	2,654	14,983	—
lectronics and communications	6,219	5,225	569	918	−504	6,203	16
ther procurement	5,880	3,068	2,286	921	−356	5,809	11
Total—Procurement	41,193	−18,904	52,029	5,228	2,719	41,072	121
rch, Development, Test, & Evaluation	—	—	—	—	−27	−27	27
ry Construction	160	−72	232	—	—	160	
ributed	76	56,216	−50,184	−8	−5	74	2
Total—Military Assistance	386,001	71,645	8,894	23,491	12,499	116,529	269,471

DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of February 1969:

DEFENSE SUPPLY AGENCY

5—Delta Petroleum Co., New Orleans, La. $1,067,091. 2,795,750 gallons of engine lubricating oil. Defense Fuel Supply Center, Alexandria, Va. DSA 640-69-D-1329 MOD P001.

—Allis Chalmers Mfg. Co., Milwaukee, Wis. $1,167,115. Gasoline-fuel, forklift trucks. Defense General Supply Center, Richmond, Va. DSA 400-69-C-4167.

10—Eastman Kodak Co., Rochester, N.Y. $1,001,211. 17,401 rolls and 32 cases of aerial motion picture film. Defense General Supply Center, Richmond, Va. DSA 400-69-D-0046.

11—Glenn's All American Sportswear, Amory, Miss. $1,257,131. 466,520 pairs of men's cotton wind-resistant poplin trousers. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1405.

—Dale Fashions, Inc., Vineland, N.J. $1,130,572. 79,682 men's wool peacoats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1448.

12—Aluminum Co. of America, Pittsburgh, Pa. $17,247,388. 56,703,600 lbs. of aluminum powder. Defense General Supply Center, Richmond, Va. DSA 400-69-C-4307.

—Alcan Metal Powders, Elizabeth, N.J. $8,099,209. 9,861,000 lbs. of aluminum powder. Defense General Supply Center, Richmond, Va. DSA 400-69-C-4308.

—Valley Metallurgical Processing Co., Essex, Conn. $1,780,680. 6,000,000 lbs. of aluminum powder. Defense General Supply Center, Richmond, Va.

13—Burlington Industries, New York, N.Y. $8,361,200. 4,000,000 yards of ripstop cotton. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1478.

—Tannenbaum Textile Co., New York, N.Y. $3,584,190. 4,000,000 yards of ripstop cotton. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1479.

—Dan River Mills, Danville, Va. $1,845,580. 2,200,000 yards of ripstop cotton. Defense Personnel Support Center, Philadephia, Pa. DSA 100-69-C-1480.

—J. P. Stevens & Co., New York, N.Y. $2,934,421. 3,350,000 yards of ripstop cotton. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1481.

—Burlington Industries, New York, N.Y. $1,252,200. 1,500,000 yards of ripstop cotton. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1482.

17—Valley Metallurgical Processing Co., Essex, Conn. $2,403,115. 3,612,500 lbs. of magnesium powder. Defense General Supply Center, Richmond, Va. DSA 400-69-C-4420.

18—M. L. W. Corp., Bayamon, Puerto Rico. $1,029,129. 428,804 pairs of men's wind-resistant cotton poplin trousers. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1503.

20—The following contracts for aviation gasoline have been awarded by the Defense Fuel Supply Center, Alexandria, Va:

Standard Oil Co., San Francisco, Calif. $5,122,783. 33,540,000 gallons. DSA 600-69-D-1441.

Sinclair Oil Corp., New York, N.Y. $5,686,114. 44,140,000 gallons. DSA 600-69-D-1440.

Mobil Oil Corp., New York, N.Y. $28,100,092. 167,913,000 gallons. DSA 600-69-D-1437.

Cities Service Oil Co., New York, N.Y. $14,036,006. 109,200,000 gallons. DSA 600-69-D-1432.

Gulf Oil Corp., New York, N.Y. $1,225,725. 8,850,000 gallons. DSA 600-69-D-1435.

Atlantic Richfield Co., Los Angeles, Calif. $5,167,680. 33,600,000 gallons. DSA 600-69-D-1430.

American Oil Co., Chicago, Ill. $1,610,460. 10,587,000 gallons. DSA 600-69-D-1429.

Chevron Oil Co., Denver, Colo. $1,628,425. 11,270,000 gallons. DSA 600-69-D-1431.

Humble Oil & Refining Co., Houston, Tex. $17,995,536. 129,654,690 gallons. DSA 600-69-D-1436.

Phillips Petroleum Co., Bartlesville, Okla. $21,601,878. 150,905,000 gallons. DSA 600-69-D-1438.

Shell Oil Co., New York, N.Y. $3,971,716. 26,940,000 gallons. DSA 600-69-D-1439.

—The following contracts for combat boots have been awarded by the Defense Personnel Support Center, Philadelphia, Pa:

Addison Shoe Corp., Wynne, Ark. $2,719,010. 326,212 pairs. DSA 100-69-C-1546.

Endicott Johnson Corp., Endicott, N.Y. $2,570,400. 315,000 pairs. DSA 100-69-C-1547.

Sportwelt Shoe Co., Nashua, N.H. $2,152,445. 240,000 pairs. DSA 100-69-C-1548.

Safety First Shoe Co., Nashville, Tenn. $3,472,000. 400,000 pairs. DSA 100-69-C-1549.

Hi-Pals Footwear, Inc., Waynesville, N.C. $2,620,699. 311,988 pairs. DSA 100-69-C-1550.

24—Shell Oil Co., New York, N.Y. $3,693,704. 2,562,000 barrels of number six fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1367.

—J. P. Stevens & Co., New York, N.Y. $2,586,870. 737,000 linear yards of wool serge cloth. Defense Personnel Supply Center, Philadelphia, Pa. DSA 100-69-C-1474.

—Burlington Industries, Inc., New York, N.Y. $1,242,790. 589,000 linear yards of tropical wool and polyester cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1477.

25—B. G. Colten & Co., New York, N.Y. $1,297,740. 794,000 yards of wind-resistant oxford cotton cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1553.

27—Gulf Oil Co., Houston, Tex. $2,634,066. 586,255 barrels of diesel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1358.

—Humble Oil & Refining Co., Houston, Tex. $1,001,960. 40,000 barrels of number six fuel oil and 422,000 barrels of Navy Special fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1360.

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company—Value—Material or Work to be Performed—Location of Work Performed (outside company plant)—Contracting Agency—Contract Number.

DEPARTMENT OF THE ARMY

3—Bell & Howell Co., Chicago, Ill. $2,302,020. Fuzes for 81mm projectiles. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0005.

—Amron Corp., Waukesha, Wis., $1,580,056. Metal parts for high explosive 20mm projectiles. Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0347.

—General Motors, Cleveland, Ohio. $11,[illegible]000 (contract modification). 155mm [illegible] propelled, medium howitzers (M109). Army Weapons Command, Rock Island, Ill. DA 11-199-AMC-00610 (W).

4—Emerson Electric Co., St. Louis, Mo. $[illegible]470,000. XM28 armament sub-systems [illegible] helicopters. Army Weapons Command, Rock Island, Ill. DA AF03 69 C 0059

5—AVCO Corp., Richmond, Ind. $2,016,[illegible] Metal parts for fuzes for 2.75-inch rockets. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09 69 C 0168

—Lockheed Aircraft, Sunnyvale, Calif. $[illegible]627,843. Equipment and services in connection with underground nuclear tests at the Nevada Test Site. Seattle, Wash. Sunnyvale, Calif. and the Nevada Test Site. Defense Atomic Support Agency. DA[illegible]01-69-C-0060.

6—Zenith Radio Corp., Chicago, Ill. $[illegible] (contract modification). Metal parts for fuzes for 2.75-inch rockets. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0093.

—American Fabricated Products Co., Indianapolis, Ind. $1,004,260 (contract modification). Fin assemblies (M149) for [illegible] mortars. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09 [illegible] C 0208.

—United Metal Cabinet Corp., Pottsville, Pa. $1,637,804. Shipping and storage containers for 20mm cartridges. Frankford Arsenal, Philadelphia, Pa. DA AA25 [illegible] C-0352.

—City of Kaw, Okla. $1,856,000. Relocation of municipal facilities at the Kaw Dam and Reservoir Project. Engineer Dist., Tulsa, Okla. DA CW56-69-C 0055.

7—Ingraham Industries, Bristol, Conn. $[illegible]588,951. M564 MTSQ and M565 M[illegible] artillery fuzes. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09 [illegible] C-0351.

—Supreme Products Corp., Chicago, Ill. $[illegible]486,000 (contract modification). Bomb [illegible] fuzes. Army Procurement Agency, Chicago, Ill. DA AA09-69-C-0074.

10—Dorsett Electronics Co., Tulsa, Okla. $[illegible]521,593. Receivers, detectors, intrusion detection sets and related manuals. [illegible] Equipment Research & Development Center, Fort Belvoir, Va. DA AK0[illegible] C 0355.

—M. Dyson Building Co., Battles Wharf, Ala. $1,355,480. Construction of a student dormitory with consolidated mess and [illegible] shelter. Fort Rucker, Ala. Engineer Dist., Mobile, Ala. DA CA01 69 C 0031.

—Wells Marine, Inc., Costa Mesa, Calif. $[illegible]239,830. Delay plungers used with [illegible] detonating fuzes. Army Procurement Agency, Chicago, Ill. DA AA09 69 C [illegible]

11—Boeing Co., Morton, Pa. $1,604,[illegible]. Rotary wing heads for CH-47 Chinook helicopters. Aviation Systems Command, St. Louis, Mo. DA AJ01-68-A-0005.

—Bell & Howell Co., Chicago, Ill. $[illegible] (contract modification). Bomblet fuzes. Evanston, Ill. Army Procurement Agency, Chicago, Ill. DA AA09 69 C 0142

12—Gichner Mobile Systems, Dallastown, Pa. $2,495,209. Electrical equipment shelters. Electronics Command, Philadelphia, Pa. DA AB05-69-C-0119.

13—Donovan Construction Co., New Brighton, Minn. $10,947,000. Metal parts for [illegible] high explosive projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0036.

—Penland Paper Converter Corp., Texarkana, Tex. $1,180,641. Fiber containers for 4.2-inch mortars. Army Procurement Agency, Chicago, Ill. DA AG11 69 C [illegible]

14—Hughes Tool Co., Culver City, Calif. $[illegible]042,800. Disassembly, inspection and [illegible] of crash-damaged OH 6A helicopters. El Segundo, Calif. Aviation Systems Command, St. Louis, Mo. DA AJ01 68 A [illegible]

—RCA, Burlington, Mass. $2,880,000. Engineering services for land combat [illegible] systems (an automated testing facility [illegible]

f surface-to-surface missiles). Command, Huntsville, Ala. C-1144.
Goodyear, Ariz $2,129,400. ating projectiles. Army Pro- ency, Pasadena, Calif DA 096.
orp., Anaheim, Calif. $1,124,- t modification) 30mm guns AH-56A Cheyenne helicop- Weapons Command, Rock Is- AF03-69-C-0033.
, Andover, Mass. $1,139,696. dification) Engineering serv- Hawk missile system. Army nand, Huntsville, Ala. DA 384.
e & Rubber Co., Akron, Ohio. rack shoe assemblies (T138) reconnaissance airborne as- , St. Mary's, Ohio Tank Au- nmand, Warren, Mich. DA 19
, Cleveland, Ohio. $1,116,916. seals for UH-1 helicopters ement Agency, Los Angeles, 07-69-C-0053.
ways Co., Sylacauga, Ala. etal parts for 155mm high jectiles (M107). Ammunition & Supply Agency, Joliet, Ill. C-0330.
ries, Vernon, Calif. $2,238,- arts for 152mm projectiles. senal, Dover, N J. DA AA21-

oducts, Northeast, Md. $1,- s for hand grenades. Ammu- rement & Supply Agency, AA09-69-C-0368.
a Co., Jackson Heights, N.Y. ontract modification). Metal 2.75-inch rocket fuzes. Y. Ammunition Procurement ncy, Joliet, Ill. DA AA09-69-

on Products, Inc., Cincinnati, 25. Metal parts for 2.75-inch Ammunition Procurement & y, Joliet, Ill. DA AA09-69-C-

, New York, N Y. $7,439,459 dification). Manufacture of ading, assembling and pack- and 8-inch projectiles, and tivities at the Army Ammu- , Joliet, Ill. Ammunition & Supply Agency, Joliet, 73-AMC-00062 (A).
e Corp., Buffalo, N.Y. $1,- ract modification). Distance bsystem for a visual airborne system. Electronics Com- Monmouth, N.J. DA 28-043-).
ric, Burlington, Vt. $3,229,- itomatic guns (M61A1) and Weapons Command, Rock Is- AF03-69-C-0027.
ic Technology Corp., Mont- Pa. $9,845,628. AN/VPS-2 istallation kits, and miscel- parts for the Vulcan Air m. Frankford Arsenal, Phil- DA AA25-69-C-0380.
nger, Silas Mason Co., New 7,016,380 (contract modifica- g, assembling and packing and for support services at munition Plant, Burlington, ition Procurement & Supply , Ill. DA AA09-68-C-0168.
Richmond, Ind. $1,218,203. or 40mm high explosive pro- Procurement Agency, Cin- DA AA09-69-C-0181.
Contracting Corp., Salem, 3. Construction excavation Athens, Ohio, Flood Protec- Engineer Dist., Huntington, W69-69-C-0053.
Harvester Co., San Diego, 49. Nine 1,100 HP gas tur- p assemblies with accessories. , San Francisco, Calif. DA 14.
Waukesha, Wis. $1,186,426 lification). Metal parts for tiles. Army Procurement go, Ill. DA AA09-69-C-0244.
ical Corp., Bristol, Pa. $3,- act modification). Loading, id packing mortar propel- flares and ammunition com- hall, Tex. Ammunition Pro- ipply Agency, Joliet, Ill. DA 0200 (A).

—Philco-Ford Corp., Newport Beach, Calif. $2,036,885. 209 sets of spare parts for the Shillelagh missile system. Army Procurement Agency, Pasadena, Calif. DA AH01-68-A-0034.
—Gocorp, Inc., Adrian, Mich. $2,579,868. Track shoe assemblies for M113 personnel carriers Tank Automotive Command, Warren, Mich. DA AE07-69-C-2745.
—Firestone Tire & Rubber Co., Akron, Ohio. $1,404,214. Road wheel disc assemblies for M48 combat tanks. Tank Automotive Command, Warren, Mich. DA AE07-69-C-2734.
—Amron Corp., Waukesha, Wis. $3,865,050. Metal parts for cartridge cases (M118), and base plugs and cups for 40mm cartridges (M406). Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0044.
—Bauer Ordnance Co., Detroit, Mich. $1,899,-631 (contract modification). Bayonets for M16A1 rifles. Army Arsenal, Rock Island, Ill. DA AF01-69-C-0224.
DA AF01-69-C-0224.
25—W. W. Clyde Co., Salt Lake City, Utah. $1,070,798. Construction of a paved extension to an existing runway; blast pad and overruns at each end of the runway and a concrete decontaminaiton pad with connecting taxiways and necessary lighting. Dugway Proving Ground, Utah. Engineer Dist., Sacramento, Calif. DA CA05-69-0061.
—Skyline Industries, Fort Worth, Tex. $2,-127,070. M1A2 demolition kits. Army Procurement Agency, Cincinnati, Ohio. DA AG-69-C-0440.
—Bell Aerosystems Co., Buffalo, N.Y. $2,180,-676. Design, development and delivery of three prototype surveillance systems for the Huey Cobra helicopter. Army Weapons Command, Rock Island, Ill. DA AF03-69-C-0064.
—Grumman Aircraft Engineering Corp., Bethpage, N.Y. $1,179,000 (contract modification). Remodernization of nine OV-1A Mohawk aircraft. Stuart, Fla. and Bethpage, N.Y. Aviation Systems Command, St. Louis, Mo. DA AJ01-68-C-1561. (K).
—AVCO Corp., Stratford, Conn. $12,663,600 (contract modification). T53L13A and T53L701 engines for use on Huey, Cobra and Mohawk aircraft. Aviation Systems Command, St. Louis, Mo. DA AJ01-68-C-1874.
26—Honeywell, Inc., Hopkins, Minn. $5,357,340 (contract modification). Grenade fuzes. New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09 68-C-0490.
—Pace Corp., Memphis, Tenn. $1,159,259 (contract modification). Two-second delay photoflash cartridges (M123A1). East Camden, Ark. and Memphis, Tenn. Picatinny Arsenal, Dover, N.J. DA AA21-69-C-0368.
—Amron Corp., Waukesha, Wis. $6,066,628. 20mm brass cartridge cases (M103). Frankford Arsenal, Philadelphia, Pa. DA AA25-69-C-0202.
—Sanders Associates, Bedford, Mass. $2,200,-171. Engineering services for the Forward Area Alert Radar system. Army Missile Command, Huntsville, Ala. DA AH01-69-C-1241.
27—Western Electric, New York, N.Y. $9,481,-500. Modification kits for the Nike Hercules missile system. Burlington, N.C. Army Missile Command, Huntsville, Ala. DA AH01-69-C-1125.
—Action Mfg. Co., Philadelphia, Pa. $1,248,-896. Metal parts for fuzes for 81mm projectiles. Army Procurement Agency, Cincinnati, Ohio. DA AA09-69-C-0246.
—Sanders Associates, Bedford, Mass. $7,102,-133. Components and test equipment for the Forward Area Alert Radar system. Army Missile Command, Huntsville, Ala. DA AH01-69-C-0749.
—Vinnell Corp. and Hyun-Dea Construction Co., Alhambra, Calif. $1,127,164. Construction of concrete covers and end wall for aircraft shelters. Kwang-ju, Suwon and Taegu Air Bases in Korea. Engineer Dist., Far East. DA CA81-69-C-0015.
28—Litton Systems, Woodland Hills, Calif. $4,-661,510. AN/ASN-86 inertial navigational systems, auxiliary items and test sets. Electronics Command, Fort Monmouth, N.J. DA AB07-68-C-0345.
—Motorola, Inc., Scottsdale, Ariz. $2,597,000 (con
and
sets
Fort
—University of Illinois, Urbana, Ill. $1,678,-000 (contract modification). Research of electronic and plasma technology for development of techniques for military application. Electronics Command, Fort Monmouth, N.J. DA AB07-67-C-0199.
—Magline, Inc., Pinconning, Mich. $1,153,-100. Electrical equipment shelters. Electronics Command, Fort Monmouth, N.J. DA AB05-69-C-0114.
—Kollett Aircraft Corp., Willow Grove, Pa. $1,742,004 (contract modification). Portable, self-contained photographic labs. Electronics Command, Fort Monmouth, N.J. DA AB05-68-C-1225.
—Chamberlain Mfg. Corp., New Bedford, Mass. $3,605,052. Metal parts for 155mm projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0377.
—Olin Mathieson Chemical Corp., East Alton, Ill. $1,324,350 (contract modification). 60mm illuminating projectiles (M83A3). Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0051.
—Olin Mathieson Chemical Corp., New York, N.Y. $1,958,877 (contract modification). Production of explosives, support services and operation of the Army Ammunition Plant, Charlestown, Ind. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0148.
—Eastman Kodak Co., Kingsport, Tenn. $5,-742,742 (contract modification). Production of explosives, support services and operation of the Holston Army Ammunition Plant, Kingsport, Tenn. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-35 (A).
—Hercules, Inc., Wilmington, Del. $10,828,-293 (contract modification). Production of explosives, support services and operation of the Army Ammunition Plant, Radford, Va. Ammunition Procurement & Supply Agency, Joliet, Ill. DA 11-173-AMC-37 (A).
—FMC Corp., Santa Clara, Calif. $3,422,781. Fabrication and assembly of 152mm canisters (XM-626). Picatinny Arsenal, Dover, N.J. DA AA21-69-C-0303.
—John R. Hollingsworth Co., Phoenixville, Pa. $1,055,470. 7.5 kw generator sets. Mobility Equipment Command, St. Louis, Mo. DA AK01-69-C-6028.
—Texas Instruments, Inc., Dallas, Tex. $1,-040,000 (contract modification). Classified work. Dallas and Sherman, Tex. Mobility Equipment Research & Development Center, Fort Belvoir, Va. DA AK02-69-C-0541.
—Hercules Engines, Canton, Ohio. $1,058,-451. Multifuel engine assemblies for 2½-ton trucks. Tank Automotive Command, Warren, Mich DA AE06-68-C-0006.
—Mine Safety Appliances Co., Pittsburgh, Pa. $2,415,685. XM28E4 riot control masks, spare parts, and test equipment. Edgewood Arsenal, Md. DA AA15-68-C-0486.

DEPARTMENT OF THE NAVY

3—Westinghouse Electric, Baltimore, Md. $9,-788,570 (contract modification). AN/APG-59 radar sets. Naval Air Systems Command. N00019-68-C-0570.
—Montgomery Ross Fisher, Inc., Los Angeles, Calif. $2,820,000. Construction of enlisted men's barracks at the San Francisco Bay Naval Shipyard, Hunters Point, Calif. Western Div., Naval Facilities Engineering Command, San Bruno, Calif. N02474-67-C-0735.
—American Electric Contracting Corp., La Mesa, Calif. $1,288,000. Construction of Pier Three utilities at the San Diego Naval Station. Southwest Div., Naval Facilities Engineering Command, San Diego, Calif. N02474-69-C-0035.
—Systems Research Corp., Washington, D.C. $1,039,300. Continuation of the preparation for the Navy's DXGN ship acquisition plan. Naval Ship Systems Command. N00024-69-C-0258.
4—Talley Industries, Inc., Mesa, Ariz. $7,690,-644. LAU-3/A rocket launchers. Naval Air Systems Command. N00019-69-C-0455.
—Varo, Inc., Garland, Tex. $6,006,800. LAU-

8/A rocket launchers. Naval Air Systems Command. N00019-69-C-0454.

5—**McDonnell Douglas Corp.**, St. Louis, Mo. $33,500,000 (contract modification). Long lead time effort and materials for RF-4C and F-4E aircraft. Naval Air Systems Command. N00019-69-C-0495.

—**General Dynamics**, Pomona, Calif. $7,125,-430 (contract modification). Research and development on the Standard Arm Missile. Naval Air Systems Command. N00019-68-C-0400.

—**Gruman Aircraft Engineering Corp.**, Bethpage, N.Y. $4,580,000 (contract modification). Increase funding for long lead time effort for A-6A aircraft. Naval Air Systems Command. NOw 66-0058.

—**Raytheon Co.**, Lexington, Mass. $1,328,010 (contract modification). Sparrow III missile guidance and control groups. Lowell, Mass. Naval Air Systems Command. N00019-68-C-0025.

6—**Whittaker Corp.**, Saugus, Calif. $11,488,-000. Aircraft parachute flares (MK N K 45, Mod O). Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0227.

—**U.S. Steel**, Pittsburgh, Pa. $11,074,800. MK 81, Mod 1, bomb bodies. McKeesport, Pa. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0243.

—**McDonnell Douglas Corp.**, St. Louis, Mo $7,400,000 (contract modification). Increase in the funding for long lead time effort and materials to support procurement of RF-4E aircraft. Naval Air Systems Command. N00019-68-C-0495.

—**Geismer & Mitchell Co.**, Jacksonville, Fla. $1,931,000. Rehabilitation of barracks and mess halls at the Naval Air Station, Cecil Field, Fla. Naval Facilities Engineering Command. N62467-67-C-0559.

—**G. L. Cory, Inc.**, San Diego, Calif. $1,209,-986. Construction of an aircraft maintenance hanger at the Naval Air Station, Imperial Beach, Calif. Naval Facilities Engineering Command. N62473-69-C-0133

—**Maxon Electronics Corp.**, Macon, Ga. $1,-162,866. Impulse cartridge (MK 2, MOD O & MK9, MOD O). Navy Ships Parts Control Center, Mechanicsburg, Pa. N00-104-69-C-0261.

—**Kilgore Corp.**, Toone, Tenn. $1,022,197. MK 25, MOD 3, marine markers. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0216.

7—**McDonnell Douglas Corp.**, Long Beach, Calif. $1,900,000 (contract modification). Increase in funding for long lead time effort to support FY 1969 production of A-4K and TA-4K aircraft. Naval Air Systems Command. N00019-67-C-0170.

—**Bendix Corp.**, Baltimore, Md. $3,007,278 (contract modification). Increase in the limitation of authorization for airbrone receiver transmitters and associated equipment. Naval Air Systems Command. NOw 66-0637.

—**Sanders Associates**, Nashua, N.H. $1,725,-041 (contract modification). Increase in the limitation of authorization for airborne receiver transmitters and associated equipment. Naval Air Systems Command. N00019-68-C-0630.

—**Triple A Machine Shop**, San Francisco, Calif. $1,080,349. Topside repairs and alterations on the amphibious transport dock USS Vancouver (LPD-2). Superviser of Shipbuilding, Conversion, and Repair, Twelfth Naval Dist., San Francisco, Calif. N62383-67-C-0012.

10—**Worthington Corp.**, Harrison, N.J. $3,484,-200. Steam turbine generator sets, associated technical data and support items. Wellsville, N.Y. Naval Ship Systems Command. N00024-69-C-5347.

—**General Electric**, Syracuse, N.Y. $2,229,-998 (contract modification). Manufacture of three AN/TPQ-10 radar course directing centrals. Naval Electronic Systems Command. N00039-68-C-0530.

—**Raytheon Co.**, Lexington, Mass. $2,000,000. Test and evaluation program to modify AN/SPG-51D radar sets. Bedford, Mass. Naval Ordnance Systems Command. N00017-69-C-2407.

11—**McDonnell Douglas Corp.**, Long Beach, Calif. $2,209,500. Strut assemblies for A-3 aircraft. Aviation Supply Office, Philadelphia, Pa. N00383-68-A-3200-0682.

—**Horne Bros.**, Newport News, Va. $1,679,318. Topside regular overhaul of the dock landing ship USS Hermitage (LSD-34). Supervisor of Shipbuilding, Conversion and Repair, Fifth Naval Dist., Norfolk, Va. N62678-69-B-98.

—**Arrowsmith Tool & Mfg. Corp.**, Los Angeles, Calif. $1,110,250. Fabrication of experimental and developmental models of ordnance items and ordnance related end products. Ridgecrest, Calif. Navy Purchasing Office, Los Angeles, Calif. N00123-69-C-0685.

12—**North American Rockwell Corp.**, Columbus, Ohio. $1,800,000. Evaluation of the feasibility of an improved target marking and light armament system for OV-10A aircraft Naval Air Systems Command. N00019-69-C-0445.

—**RCA**, Princeton, N.J. $1,540,508 (contract modification). Exploratory and developmental work on a communications project. Naval Electronic Systems Command. N00039-68-C-1518.

13—**Johns Hopkins University, Applied Physics Laboratory**, Silver Spring, Md $1,514,120. Increased research and development work on Project Bumblebee. Naval Ordnance Systems Command. NOw 62-0604.

—**Gibbs Mfg. & Research Corp.**, Janesville, Wis $3,488,475. MK 346 bomb fuzes. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0231.

14—**General Electric**, Washington, D.C. $1,-250,000. Two gas turbine engines and installation and test aboard ship. Naval Ship Systems Command N00024-69-C-5331.

17—**Honeywell, Inc.**, St. Petersburg, Fla. $7,-906,902 inertial components for Poseidon missiles. Strategic Systems Project Office. N00030-69-C-0084.

—**General Time Corp.**, LaSalle, Ill. $2,614,-180 Mechanical time fuzes (MK 342, MOD O) for five-inch gun ammunition. Peru, Ill. Navy Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0247.

—**Genge Industries**, Oxnard, Calif. $1,957,-785. Drafting, technical writing and illustrating work for the Naval Weapons Center, China Lake, Calif. Ridgecrest, Calif. Navy Purchasing Office, Los Angeles, Calif. N00123-69-C-0031.

—**Trepte Construction Co.**, San Diego, Calif. $1,668,730 Construction of boat repair facilities at the Naval Amphibious Base, Coronado, Calif Naval Facilities Engineering Command. N62473-68-C-0114.

18—**Honeywell, Inc.**, Hopkins, Minn. $51,347,-202. Production of MK 46, MOD 1, torpedoes. Naval Ordnance Systems Command. N00017-69-C-1307.

—**Johns Hopkins University, Applied Physics Laboratory**, Silver Spring, Md. $7,043,168 (contract modification). Increased research and development on Project Bumblebee. Naval Ordnance Systems Command. NOw 62-0604C.

19—**Litton Systems**, Woodland Hills, Calif. $1,-084,100. Inertial navigation systems and associated equipment. Naval Air Systems Command. N00019-69-C-0451.

—**LTV Aerospace Corp.**, Dallas, Tex. $6,-245,364 (contract modification). Changes to extend the service life of F-8A/B and C aircraft. Naval Air Systems Command. N00019-68-C-0191.

20—**General Electric**, Schenectady, N.Y. $8,-738,000. Design and furnishing of Navy nuclear propulsion components. Naval Ship Systems Command. N00024-69-C-5154.

—**Scripps Institution of Oceanography**, La Jolla, Calif. $3,041,687. Oceanographic research. Office of Naval Research.

—**Sperry Rand Corp.**, St. Paul, Minn. $1,-670,390. Computer components, spare parts, and engineering services. Naval Ship Systems Command. N00024-69-C-1137.

—**Sperry Rand Corp.**, St. Paul, Minn. $1,-067,758. A study of the combat system of the nuclear guided missile destroyer (DXGN). Naval Ship Systems Command. N00024-69-C-1233.

24—**Sperry Rand Corp.**, St. Paul, Minn. $3,-179,630. Services, material for maintenance, design, development, production and delivery of computer programs for YP-3C/T-3C anti-submarine warfare avionics systems and VP-ANEW avionics. Johnsville, Pa. and St. Paul, Minn. Naval Air Development Center, Johnsville, Pa. N62269-69-C-0187.

—**Curtiss Wright Corp.**, Wood-Ridge, N.J. $1,705,550. J65 engines used in A-4A, B and C aircraft. Aviation Supply Office, Philadelphia, Pa. F41608-69-A-0057-GB54.

26—**General Precision Systems**, Little Falls, N.J. $2,500,000. Support equipment for AN/ASN-90 inertial measurement systems used on A-7E aircraft. Aviation Supply Office, Philadelphia, Pa. N00383-68-A-8201-0111.

—**Norfolk Shipbuilding & Drydock Co.**, Norfolk, Va. $1,233,000. Regular topside overhaul of the dock landing ship USS San Marcos (LSD-25). Supervisor of Shipbuilding, Conversion and Repair, Fifth Naval Dist., Norfolk, Va. IFB N62678-69-B-27.

—**M.I.T.**, Cambridge, Mass. $2,210,000. Research on Poseidon guidance systems. Strategic Systems Project Office. N00030-69-C-0089.

27—**LTV Aerospace Corp.**, Dallas, Tex. $211,-459,083 (contract modification). A-7E aircraft, $27,528,986 contract modification. A-7D aircraft Naval Air Systems Command. N00019-68-C-0075. N00019-68-C-0143.

—**United Aircraft**, Hartford, Conn. $31,253,-467 (contract modification). J52-P-8A engines. Naval Air Systems Command. N00019-67-C-0182.

—**Grumman Aircraft Engineering Corp.**, Bethpage, N Y. $7,600,000 (contract modification). Long lead time effort and materials for FY 1970 Procurement of EA-6B Aircraft. Naval Air Systems Command N00019-67-C-0078.

—**General Electric**, West Lynn, Mass. $5,-800,000 (contract modification). Engineering development of TF-34 turbofan engines for VSX aircraft. Naval Air Systems Command. N00019-68-C-0443.

—**Boeing Co.**, Morton, Pa. $5,242,000 (contract modification). Increased funding and extension of long lead time for CH-46D helicopters. Naval Air Systems Command N00019-68-C-0301.

—**North American Rockwell Corp.**, Columbus, Ohio. $2,450,000 (contract modification). Design, development, fabrication and test of a naval intelligence processing system. Naval Air Systems Command. N00019-68-C-0525.

—**Westinghouse Electric Corp.**, Baltimore, Md. $2,450,000 (contract modification). Modification kits for the AN/APG-59 radar to incorporate a digital computer to replace existing analog computers. Naval Air Systems Command. N00019-69-C 0064.

—**Sylvania Electric Products**, Mountain View, Calif. $1,558,252 (contract modification). Electronic counter-measure systems for EA-3B aircraft. Mountain View and Santa Cruz, Calif. Naval Air Systems Command. N00019-68-C-0499.

—**Singer-General Precision, Inc.**, Wayne, N.J. $1,700,000. Research on Poseidon guidance systems. Strategic Systems Project Office N00030-69-C-0086.

—**Lormack Corp.**, Upper Marlboro, Md. $1,-162,000. Construction of a dispensary and dental clinic at Bolling AFB, Washington, D.C. Chesapeake Div., Naval Facilities Engineering Command, Washington, D.C. N62477-67-B-0926.

28—**United Aircraft**, Hartford, Conn. $6,300,-000. Design and development of the J52-P-400 engine. Naval Air Systems Command. N00019-69-C-0290.

—**Marshall Building & Constructing Corp.**, Upper Darby, Pa. $1,896,000. Construction of 100 family housing units at the Naval Base, Philadelphia, Pa. Naval Facilities Engineering Command. N62472-69 B-0015.

—**Burroughs Corp.**, Paoli, Pa. $1,639,144. Classified equipment. Naval Ordnance Systems Command. N00017-69-C-1402.

—**Stanwick Corp.**, Arlington, Va. $1,380,415. Development of maintenance information products for analysis by various naval commands. Naval Ship Systems Command. N00024-69-C-5024.

—**Richard K. W. Tom, Inc.**, Honolulu, Hawaii. $1,088,111. Construction of a nuclear overhaul facility, at the Naval Shipyard, Pearl Harbor, Hawaii. Naval Facilities Engineering Command. N62472-69-C-0320.

DEPARTMENT OF THE AIR FORCE

3—**AVCO Corp.**, Everett, Mass. $1,000,000 Research and exploratory development on laser technology. Special Weapons Center, Kirtland AFB, N.M. F29601-69-C-0060.

—Hughes Aircraft, Culver City, Calif. $1,600,000. Research and exploratory development on laser technology. Special Weapons Center, Kirtland AFB, N.M. F29601-69-C-0058

4—General Electric, Philadelphia, Pa $4,400,000. Research and development of the MK 12 re-entry system. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. AF04-694-916

5—Radiation, Inc., Melbourne, Fla. $5,800,000. Development and production of airborne communications equipment. Palm Bay, Fla. Electronic Systems Div., (AFSC), L. G. Hanscom Field, Mass. F19628-69-C-0159.

6—United Aircraft, Hartford, Conn. $1,166,878. Fabrication of forgings applicable to J-57 aircraft engines. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. N383-69000A.

—Kollsman Instrument Corp., Elmhurst, N.Y. $1,876,000. Production of altimeters (AAU-19/A). Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-0569.

—Chicago Aerial Industries, Barrington, Ill. $2,375,000. Production of airborne cameras (LS-42A) for RF-4 and RF-5 aircraft. Ogden Air Materiel Area (AFLC), Hill AFB, Utah. F42600-69-C-1260.

7—Continental Aviation & Engineering Corp., Detroit, Mich. $1,424,520. Production of J-69-T-41 aircraft engines. Toledo, Ohio. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0229.

—Thiokol Chemical Corp., Brigham City, Utah. $2,189,199. Basic rocket motors and related data applicable to Genie rockets. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-68-A-2881.

—General Electric, Utica, N.Y. $2,607,000. Production of airborne countermeasure equipment (AN/ALQ-87 V). Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0821.

10—Computer Sciences Corp., El Segundo, Calif. $4,305,295. Services and supplies for the development, installation, operation, test and maintenance of hardware to improve space track equipment (AN/FPS 79 & 80 of 496L System). Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-C-0508.

—McConnell Douglas Corp., St. Louis, Mo. $2,690,335. Modification of RF-4C aircraft. Robertson, Mo. Ogden Air Materiel (AFLC), Hill AFB, Utah. F34601-68-A-2919.

—General Electric, Cincinnati, Ohio. $8,135,656. Production of J79-GE-15 engines for RF-4C aircraft. Evendale, Ohio. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-1232.

—United Technology Center, Sunnyvale, Calif. $1,600,000. Launch services and related support for operation and maintenance of Cape Kennedy launch facilities. Cape Kennedy, Fla., and Sunnydale, Calif. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0036.

—LTV Electro Systems, Dallas, Tex. $2,000,000. Development of test equipment to simulate missile flights. Garland, Tex. Space & missile Systems Organization. (AFSC), Los Angles, Calif. F04701-69-C-0297.

13—General Electric, Cincinnati, Ohio. $8,027,700. Production of J79-GE-10 turbojet engines in support of the F-4J and RA-5C aircraft programs. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-0263.

17—Continental Aviation & Engineering Corp., Detroit, Mich. $1,147,410. J69-T-29 engines and related data. Toledo, Ohio. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0297.

—Wall Colomonoy Corp., San Antonio, Tex. $1,661,821. Repair of jet engine parts. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41608-69-D-0623-0003.

—Pascoe Steel Corp., Pomona, Calif. $1,400,260. Production of nylon ballistic closures for aircraft shelters. Hq., Air Force Logistics Command, Wright-Patterson AFB, Ohio. F33600-C-69-0374.

18—American Electric, Inc., La Mirada, Calif. $1,360,200. Production of 750-lb. bomb assemblies. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-2785.

—Continental Aviation & Engineering Corp., Detroit, Mich. $1,974,024. Production of J69-T-29 aircraft engines. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0362.

—Contracting Machine Corp., Burlington, Mass. $1,668,647. Production of bomb components Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-2936.

—Maxson Electronics Corp., Great River, N.Y. $3,885,631. Production of components applicable to general purpose bombs. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F34601-68-A-2701.

—United Aircraft, Hartford, Conn. $1,087,252. Production of bearings applicable to J57 and TF33 aircraft engines. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. N383-69000A – SA-69-1071.

19—United Aircraft, West Palm Beach, Fla. $2,000,000. Research and exploratory development work in the field of laser technology. Air Force Special Weapons Center, (AFSC), Kirtland AFB, N.M. F29601-69-C-0069.

—Page Communications Engineers, Washington, D.C. $1,742,218. Mobile communications equipment (AN/MRC-113) Long Island City, N.Y. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F03460-69-C-2845.

24—North American Rockwell Corp., Anaheim, Calif. $2,678,100. Minuteman III weapon system spare parts. Ogden Air Material Area. (AFLC), Hill AFB, Utah. F04701-68-C-0174-QP04

—Ryan Aeronautical Co., San Diego, Calif. $1,284,880. Parachute compartments and components for mid-air retrieval systems. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-A-0175-0001.

25—Hughes Aircraft, Culver City, Calif. $1,250,000. Retrofit kits for Falcon air-interceptor missiles. Tucson, Ariz. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-69-C-0941.

—Thiokol Chemical Corp., Brigham City, Utah. $1,111,132. Component assemblies (adaptor and loaded case assemblies) for Bomarc missiles. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-2176.

—United Aircraft, Hartford, Conn. $1,138,959. Production of castings applicable to J-57 aircraft engines. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. N383-6900A SA-69-1070.

26—McDonnell Douglas Corp., Tulsa, Okla. $1,576,000. Modification kits for RB-66 aircraft. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F34601-68-A-3033-RJ05.

—TRW, Inc., Redondo Beach, Calif. $1,101,000. Refurbishment of AN/ASQ-90 airborne electronics equipment. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0912.

27—General Motors, Indianapolis, Ind. $3,801,800. Development work on the direct lift aircraft engine program. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. AF33(768)16626 (SA 13).

28—United Aircraft, Hartford, Conn. $1,203,536. Production of spare parts for J-57 aircraft engines. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. N383-6900A SA-69-1069.

OFF-SHORE PROCUREMENT

6—Scott Lithgow Drydocks, Ltd., Greenock, Scotland. $2,843,500. Overhaul and repair of the floating dry dock, Los Alamos (AFD B-7). Navy Purchasing Office, London, England. N62558-69-C-5015.

—Canadian Commercial Corp., Ottawa, Canada. $1,107,000. Pressure-temperature test sets. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41608-69-C-7806.

11—Canadian Commercial Corp., Ottawa, Ontario, Canada. $1,156,095. Modification kits, support spares and data applicable to the URT-26 system—a beacon transmitter for aircraft. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga.

—Northern Transportation Co., Ltd., Edmonton, Alberta, Canada. $1,187,450. Water transportation for the annual resupply of DEWLINE sites along the Arctic Coast. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-C-0479.

Naval Material Command

(*Continued from page 7*)

Vietnam must be met. Ammunition, spare parts, fuel, overhaul, and training requirements are pressing our support establishment to the limit. At the same time, the normal peacetime emphasis on economy continues in full force: cost reduction, reduction in personnel, curtailment of overtime, stress on competitive buys, set-asides for small business, and many others. Contrast this with our World War II experience, when we simply buried the enemy with our production, and waited until after VE day to count the costs. Operating in the twilight zone presents a challenge that is almost without precedent.

The Naval Material Command works to meet this challenge, along with the normal challenge of providing the Fleet with warfare systems that meet the military needs, yet are fully supportable and economically feasible, through a unified, cohesive management structure and philosophy. The command is huge, and it has many "systems," but it must work as a whole; it must be truly a system of systems.

Launch Complex 30 at Cape Goes to Navy

Launch Complex 30 at Cape Kennedy Space Center, Fla., has been turned over to the Navy's Underwater Weapons Research and Engineering Station, Newport, R.I.

The Navy will convert the former Pershing missile test firing site to a facility to be used in evaluating its new MK 48 torpedo weapon system.

The *Defense Industry Bulletin* mailing list is prepared by computer. When requesting a change in address or stopping a subscription, readers must send the mailing label from the back cover of the magazine. Without this label, changes cannot be made. Do not alter or deface the label. Allow two months for change of address. Changes and labels should be sent to the Editor, Defense Industry Bulletin, OASD (Public Affairs) The Pentagon Washington, 20301.

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Ramey AFB Site of New SOFNET Solar Observatory

The Air Force has taken another stride forward in keeping a scientific eye on the sun with the opening of a new solar observatory in the Caribbean. The new telescope is located at Ramey AFB, Puerto Rico, and is the latest addition to the Air Force Solar Observing and Forecasting Network (SOFNET). Installation was managed by the Air Force Systems Command's Electronic Systems Division.

SOFNET observatories are located at key points around the world to monitor the solar activity and gather forecast information for predicting geophysical effects. Network locations include Greece, Hawaii, the Philippines, Puerto Rico, and U.S. sites in New Mexico, California and Massachusetts.

Information from the Ramey observatory and other sites is funneled into the Solar Forecast Center, at the North American Air Defense Command's Cheyenne Mountain Complex in Colorado.

The telescope system permits simultaneous observation, remote television monitoring, and photographic recording by an electrically programmed camera to permanently document solar phenomena. At sunrise its celestial coordinates are set by a station operator and the system's sun-follower is activated. The system does the rest. Tracking and photography are automatic.

Accurate predictions of solar-flare eruptions, by Air Weather Service observers and forecasters, have important bearing on improvement of sky-wave radio communications as well as manned spaceflight programs.

Violent solar explosions emit great amounts of X-rays and high-energy atomic particles. Increased radiation from a solar flare can black out pilot-to-ground communications, disrupt long-distance high-frequency radio communication, change low altitude satellite orbits, and produce dangerous radiation levels for unprotected astronauts in space. Such events can wipe out long distance communications for more than an hour. It is these operational problems the Air Force is working to solve.

Army Seeks Ideas for Future Missiles

The Army Missile Command, Redstone Arsenal, Ala., has issued requests for quotations asking industry to take an early look at its requirements for future missiles, and submit worthwhile ideas on four systems problems.

The four future systems are: a tank type device with emphasis on firepower; a completely new weapon system to replace the present light anti-tank assault weapon; an anti-tank assault air defense weapon which could be suitably effective in either an anti-tank or air defense role; and a new generation of artillery type missiles to be fired from Army aircraft.

By making qualified contractors aware of the Army's problems and asking them how they would describe new and unique ideas to solve the problems at the beginning of a research effort, substantial time saving is anticipated during the later development phases.

Technical supervision of the research and development effort is the responsibility of the Future Missile Systems Division of the Missile Command's Research and Engineering Directorate.

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IN THIS ISSUE

FEATURES

DEPARTMENTS

Cover features artist's concept of new F-15 aircraft, designed to give the U. S. Air Force a true air superiority fighter in the 1970s and beyond. Acquisition of the F-15 weapon system is within the mission of the Air Force Systems Command, whose story begins on page 24 of this issue.

ense Budget Reassessed—

Secretary Laird's Proposals to Congress . . .

r's Note: The following ar- devoted to the statement of orable Melvin R. Laird, Sec- f Defense, before the Senate Services Committee on March as later revised in his state- fore the House Armed Serv- mittee on April 1, 1969. Sec- aird's statements reassess the supplemental and FY 1970 de- dget goals enunciated by the Administration, proposing lower levels of spending for ing fiscal year. It should be at the Secretary of Defense cated the possibility of fur- ndments to the defense budg- d continuing review so dic-

hairman, in my 14 years as r of the House Subcommittee ase Appropriations, I never hesitated to state my views on all important defense issues. In my new role as Secretary of Defense, I, of course, realize the necessity of avoiding preconceptions and of basing my recommendations to the President and the Congress on the circumstances *now* prevailing and on all of the relevant data *now* available to me as Secretary of Defense.

It was in this spirit that Deputy Secretary of Defense David Packard and I undertook the task of reassessing the FY 1969 defense supplemental and the FY 1970 defense budget, prepared by the previous Administration and transmitted to the Congress on Jan. 15, 1969.

Our decision to undertake the major reassessment of the 1969 supplemental and the 1970 budget will not, I hope, be interpreted as a reflection on the work done by our predecessors. . . . We do, of co with them in some respec our assessment of the worl and the relative emphasis believe should be given to v ments of the defense progra

Obviously, however, the at the Pentagon has not since assuming office on J to review all of the prog activities involved in comp nor, obviously, to review all policy objectives and as upon which they were base proached our task with two in mind:

- To conduct a compreh view of our overall nationa policies—political and eco well as military.
- To initiate only those which we felt were urgentl in the FY 1969 defense sup and the FY 1970 defens pending completion of our hensive review.

Realistically, we felt it possible for a brand new A tion to conduct a thorough tive review of the FY 1970 time for the present sessi Congress to act upon such The first comprehensive pr the Nixon Administration w fore, be reflected in the budget submission next year.

* * * * * * *

The rationale for the programs proposed by the preceding Administration is set forth in former Secretary of Defense Clifford's annual posture statement, copies of which I understand have been furnished to this Committee. [Editor's note: Statement by former Secretary of Defense Clifford on FY 1970 defense budget and the FY 1970–74 defense program released Jan. 15, 1969, was published in article "Defense Budget Highlights," *Defense Industry Bulletin*, March 1969, page 1.] The changes which I have recommended to the Bureau of the Budget and the President will be summarized in the amendments transmitted to the Congress. My purpose here this morning is to present these changes in greater detail and explain to this Committee why we believe they will improve our overall defense posture in the years ahead. Where we do not now have a sound and sufficient basis for change, we recommend that the January budget requests be permitted to stand. As I mentioned earlier, the FY 1971 budget will be the first Nixon Administration budget, and will be based on the completed reassessment. If, during the next two or three months, our continuing study reveals that additional changes in the FY 1970 budget require urgent Congressional action, we will bring them promptly to your attention.

In making our review for this submission to the Congress and, in our overall assessment, we decided to be guided by the following considerations:

Southeast Asia Requirements.

As long as U.S. military forces are engaged in combat operations in Southeast Asia, their essential needs must be met without exception. Furthermore, we must always be prepared for sudden surges of combat activity, *i.e.*, large-scale Communist offensives. At the same time, we must take fully into account the latest experience data in computing our requirements. These data include activity, consumption and attrition rates; stock levels in Southeast Asia and world-wide; the expansibility of the "going" production base; etc. With the Korean war experience in mind, we must be particularly careful at this stage of the conflict in Southeast Asia to avoid overstocking and to draw down or redistribute any excesses which may have already accumulated.

Non-Southeast Asia General Purpose Force Requirements.

The overriding priority given to the needs of our forces in Southeast Asia during the last three and one-half years has apparently caused some significant distortions in the overall balance of our General Purpose Forces. Although it is highly unlikely that these imbalances can be fully rectified until the conclusion of the conflict in Southeast Asia, we are exploring the possibilities of doing more to correct some of them during the FY 1970 budget period.

Strategic Forces Requirements.

The rapid buildup of Soviet strategic forces during the last two or three years—*e.g.*, intercontinental ballistic missiles, new surface-to-air-missiles and manned interceptors, and the projected increase in submarine-launched ballistic missiles—is a cause for concern with regard to the overall strategic balance between the United States and the Soviet Union. Similarly, Communist China's progress in the development of nuclear armed ballistic missiles may soon pose a new strategic threat to the United States. Accordingly, special attention must be given now to the adequacy of our own strategic offensive and defensive forces, over both the near term and the long term.

Readiness for Production.

Many of the serious problems encountered in the deployment of major weapon systems (delays, cost overruns and failure to meet performance specifications) could probably be avoided if more time were taken to complete development, test and evaluation of the critical subsystems and components. In fact, the tendency to rush into large-scale production before development has been completed may well cost more time and money over the long run, than a more systematic and orderly approach. While each case must be judged on its own merits, taking into account the state of the art and the urgency of the requirement, it would appear that as a general rule we would be better off with more realistic scheduling. Accordingly, each new major weapon systems program reflected in the FY 1969–70 budgets will be reviewed to ensure that the development and production schedules proposed are truly attainable, not only in terms of time, but of cost and performance as well.

Military Pay Reform.

Manpower requirements for the future necessitate the modernization of military compensation to ensure effectiveness and equity to all concerned. Accordingly, we have undertaken a comprehensive review of this complex issue in order to meet this requirement. We have studied the Pay Plan proposed by the previous Administration but, based on our study, we have concluded that much more extensive work is necessary before submitting our recommendation.

Economy and Efficiency.

In view of the potentially dangerous economic and fiscal situation in which the nation now finds itself, all demands on the Federal budget must be matched against a strict set of national priorities. Accordingly, we are searching out every area for potential reductions, including:

- Programs and activities which contribute only marginally to our defense posture must be eliminated.
- While President Nixon supports the previous Administration's request for relief from the civilian personnel reductions imposed by the Revenue and Expenditure Control Act of 1968, he expects each department and agency to hold its civilian employment at the minimum compatible with the efficient conduct of its operations. In this connection, particular attention will be given to overhead activities. The buildup for the Vietnam conflict has been completed and it should now be possible to shake down the organization and eliminate activities which are no longer needed.
- The Defense Department, particularly over the last three years, has accumulated a substantial backlog of needed military construction projects. Several years will be needed to work it off in a reasonable manner. It is, therefore, imperative that all unneeded or marginal installations be closed, or their activities consolidated at other installations.

Scope of National Security Problems

Before I discuss the proposed changes to the FY 1969 supplemental and the FY 1970 budget, I would like

to mention briefly the scope of the national security problems which we find ourselves facing as we begin the work of the new Administration.

In view of the major reassessment now in progress by the National Security Council, I will not attempt a comprehensive discussion of our national security problems around the world. Such a discussion must await the results of our own reassessment. I will merely touch on the problems we face to indicate the enormity of the undertaking which confronts the new Administration. Never have the challenges to our national security exceeded in number and gravity those which we found upon taking office.

At the forefront is the war in Vietnam. Along with the war itself, we have inherited a backlog of many years' accumulation of ground rules, operating procedures and unwritten understandings which multiply the complexities. I will say more about Vietnam in just a moment.

Nearby in Laos, Communist forces, including some 40,000 North Vietnamese in addition to the indigenous Pathet Lao, have recently dealt serious setbacks to the Laotian armed forces, and could probably overrun the entire nation at will. Such a development would bring North Vietnamese troops right up to the border of Thailand.

To the north, on the Korean Peninsula, a peace hangs by a slender thread. The North Korean regime, backed by large and well equipped armed forces, still loudly proclaims its aggressive intent with respect to the Republic of Korea in the South. The threats of the regime are underlined by their attempt last year to assassinate the President of the Republic of South Korea, their seizure of the Pueblo which they still hold illegally, and their continued efforts to infiltrate armed bands into the South.

Communist China, nevertheless, still constitutes the most dangerous potential for threatening the peace in Asia. Its vast army and relatively large air and naval forces are now on the verge of being supplemented by an operational nuclear capability, giving Communist China the possibility of being one of our gravest national security problems in the 1970s.

In South Asia, a potential security problem is posed by the withdrawal of United Kingdom military forces from Malaysia/Singapore by the end of 1971. Australia and New Zealand have recognized this problem by announcing their intent to maintain a military force there.

In the Middle East, the almost daily clashes indicate that the Arab-Israeli conflict verges on an active state of war, with the imminent threat of expansion. This situation is complicated by the continuing flow of Soviet Arms to their Arab clients.

In Europe, the extent of our national security problems was put into sharp focus by the Soviet invasion of Czechoslovakia, the speed and efficiency with which the invasion was carried out, and the recent Berlin harassment. Against this backdrop, we must deal with a NATO beset with both military and political problems of no small magnitude.

We are confronted with a marked increase in Soviet strategic weapons capability, both offensive and defensive, a challenge that is of serious import.

There has also been a distinct buildup in Soviet general purpose forces. As you know, the Soviets are increasing their naval capabilities in the Mediterranean and the Indian Ocean, as well as increasing their involvement in Middle East affairs. At the same time, the Russian research and development effort is still going forward at a vigorous pace. All of this is reflected, of course, in the increased military budget of the Soviets.

Complicating all of these problems are serious U.S. and free world balance of payments difficulties; an imbalance in our readiness caused by the war in Vietnam; the increasing competition for resources within the United States; and the threat, if indeed not the actuality, of unsatisfactory price instability.

Vietnam

It is the Vietnam situation that I would like to discuss with the Committee for a few moments, in order to give you a brief report on my observations after my recent trip to that beleaguered country.

Since the last week in February, enemy forces have been engaged in a new offensive in South Vietnam. This has consisted primarily of attacks by fire against American and allied military bases. In addition, there has been a troubling frequency of attacks on the civilian population, including rocket attacks on Saigon, DaNang, and Hue.

From the military standpoint, our military commanders believe the current enemy offensive is destined for failure. Ambassador Bunker, General Abrams, our commanders in the field, and the leaders of the government of the Republic of Vietnam are in unanimous accord that the enemy's efforts will gain no territory permanently, nor will they bring about any lasting reduction in the level of pacification. The recently initiated enemy action has had surprisingly little impact on the morale of the South Vietnamese people and their government. At the same time, however, the enemy's escalation of activity has increased substantially the U.S. and South Vietnamese casualty rates.

While the military leaders in South Vietnam assured me that this offensive can and will be contained, they also conceded the enemy's ability to conduct similar offensives in the future, at least on an intermittent basis. This continued capability on the part of the enemy derives from certain intractable factors in the Vietnamese situation. The forces of Hanoi and the National Liberation Front continue to be supplied with sophisticated equipment and weapons, such as 122mm rockets from Soviet and Communist Chinese resources. In addition, the enemy forces are able to take refuge in sanctuaries across the borders of Laos, Cambodia, and North Vietnam. The Laotian and Cambodian sanctuaries are of great importance in the enemy's ability to withstand our overwhelming superiority in mobility and firepower. Moreover, Cambodia has become increasingly important in the infiltration of supplies and men, and in the command and control of the enemy forces.

The indiscriminate enemy rocket attacks on Saigon, DaNang and Hue are not militarily significant. As of this time, the attacks have added to the degree, but not to the type, of risk to which U.S. forces have for some time been subjected. These attacks, furthermore, have as yet done little to affect adversely the morale of the South Vietnamese public. At the same time, there can be no doubt that the rocket attacks in Saigon, DaNang and

"... we must greatly increase our effort to improve capabilities of the South Vietnamese armed forces ..."

Hue are completely inconsistent with the understandings which underlie the bombing halt.

As you will recall, the position of the present Administration on this matter was stated by President Nixon in his press conference on March 4. In reply to a question on how we might respond if these attacks were to continue in South Vietnam, he said:

> **"... the United States has a number of options that we could exercise to respond. We have several contingency plans that can be put into effect.**
>
> **"I am considering all of those plans. We shall use whatever plan we consider is appropriate to the action on the other side. I will not indicate in advance, and I am not going to indicate publicly, and I am not going to threaten—I don't think that would be helpful—that we are going to start bombing the North or anything else.**
>
> **"I will only indicate that we will not tolerate a continuation of this kind of attack without some response that will be appropriate."**

In addition to containing the current enemy offensive, allied military efforts are reported to be making steady progress. For example, during my recent trip to Vietnam, both General Cushman and General Stilwell cited significant advances in I Corps in eliminating enemy influence, including the Viet Cong infrastructure (VCI). General Cushman, however, informed me that an additional two years would be required before he could see the situation as being satisfactorily in hand. It is apparent that a successful anti-infrastructure effort will, thus, require a substantially higher enemy rate of attrition than has yet been realized.

Militarily, I was assured by our military commanders that the situation in III Corps is under control. General Abrams believes his tactics and precautions have greatly reduced the risks of significant enemy incursion into the capital city of Saigon. The mortar and rocket attacks have been relatively infrequent and unimpressive in number. In the IV Corps area as well, the military situation is steadily moving in a direction favorable to the government of the Republic of Vietnam and the United States. However, Major General Eckhart, the senior U.S. Military Adviser in IV Corps, recognizes that the pacification effort is proceeding slowly in this traditional Viet Cong stronghold.

The basic problem remains that of achieving permanent South Vietnamese governmental control over the country. Although Ambassador Bunker gives persuasive documentation of steady political growth by the government of South Vietnam, this progress is difficult to translate into nationwide security. Even greater national exertion will be necessary to bring administration and political structures of the government of the Republic of Vietnam into the villages and hamlets of South Vietnam. This would be an extremely difficult task under peaceful circumstances; it is monumental while hostilities continue at the present level.

Readiness and Progress of Republic of Vietnam Armed Forces

The regular, irregular and police forces of South Vietnam now include over one million men. The arms and equipment furnished by the United States have increased both in quantity and quality.

I regret to report, however, that I see no indication that we presently have a program adequate to bring about a significant reduction in the U.S. military contribution in South Vietnam. The current operating assumption, as stated to me, is that even the currently funded modernization program for the South Vietnamese forces will equip the South Vietnamese forces only to withstand the Viet Cong insurgents that would remain, after all North Vietnam forces had been withdrawn to North Vietnam. Also, the presentation given to me by the staff of the Military Advisory Command, Vietnam, (MACV) was based on the premise that no reduction in U.S. personnel would be possible in the absence of total withdrawal of North Vietnamese troops. Our orientation seems to have been more on operations than on assisting the South Vietnamese to acquire the means to defend themselves.

About a year ago, the government of South Vietnam undertook a general mobilization to expand the armed forces to more than 800,000 by the end of FY 1969 and, in connection therewith, the U.S. Government assumed the task of equipping those

forces and modernizing the
orces so that they could
ke over more of the combat

all modernization program
d into two phases: Phase
or the maximum possible
land forces combat capa-
uming continued U.S. par-
n the war at the then cur-
Phase II called for the
it of indigenous forces,
ld be capable of suppress-
ency on their own if North
and U.S. forces were

the budget request trans-
the Congress in January,
about $1.1 billion has been
d for Phase I ($532 mil-
FY 1970 budget, $351 mil-
e FY 1969 supplemental,
on reprogrammed from
Y 1969 funds, and $65 mil-
FY 1968 supplemental).
) million of the Phase I
earmarked for procure-
it $600 million for tracked
iicles, trucks, weapons and
i; and most of the re-
bout $160 million, for air-
ut $300 million is ear-
r operations and mainte-
port of the South Viet-
ces—general supplies and
, training, operations, etc.
s were included in the
dget request for Phase II
am informed, the require-
not yet been defined. How-
e basis of my discussions
ssador Bunker and Gen-
is during my recent visit
ietnam, and on the basis
liminary reassessment of
needs and requirements,
to the conclusion that we
least start Phase II this
doing so, however, solely
s that this would permit
the process of replacing
ombat forces with South
military and para-mili-
onnel that are better
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ore.

wish to mislead this Com-
what I am talking about
not talking about the with-
American troops at the
. As President Nixon said
o a question at his press
n March 14:

"... in view of the current offensive on the part of the North Vietnamese and the Vietcong, there is no prospect for a reduction of American forces in the foreseeable future.

"When we are able to reduce forces as the result of a combination of circumstances—the ability of the South Vietnamese to defend themselves in areas where we now are defending them, the progress of the talks in Paris, or the level of enemy activity—when that occurs, I will make an announcement. But at this time there is no foreseeable prospect in that field."

Therefore, the change I am talking about represents not only increased funding for modernization of the armed forces of South Vietnam; it also represents the establishment of a new objective for this modernization which has not previously existed, namely, the effective assumption by the Republic of Vietnam armed forces of a larger share of combat operations from American forces. Frankly, while it may be difficult to carry out U.S. force reductions until South Vietnamese forces are capable of replacing the forces that we reduce or withdraw, we must greatly increase our efforts to improve capabilities of the South Vietnamese armed forces, and to work toward a situation in which U.S. forces can, in fact, be withdrawn in substantial numbers.

Accordingly, we propose to add approximately $36 million in FY 1969 and approximately $120 million in FY 1970 for this purpose. About $26 million of the FY 1969 funds and $75 million of the FY 1970 funds would be used to procure equipment for the South Vietnamese ground forces—armored carriers, trucks, trailers, radios and night vision devices, etc. The remaining $10 million of the FY 1969 funds and $23 million of the FY 1970 funds would be used for training, general supplies and spare parts, transportation, and depot operations associated with the major end items to be provided. About $20 million of the FY 1970 funds would be used to prepare the South Vietnamese air force to operate more advanced aircraft. A small amount, about $2 million, would be used for the modernization of the South Vietnamese navy—for the overhaul and operation of a few U.S. vessels to be turned over to them.

Proposed Adjustments to the FY 1969 Supplemental and FY 1970 Budget

Our recommended changes to the FY 1969 supplemental and FY 1970 budget requests, transmitted to the Congress by the preceding Administration in January, are summarized by general category in Table 1 attached to this statement. [Financial tables referred to in Secretary Laird's statement appear on pages 16 to 19 of this issue.] The original and revised budget estimates are shown by appropriation account in the next two tables—the FY 1969 supplemental in Table 2 and the FY 1970 budget in Table 3. The original and revised amounts requested for authorization in FY 1970 are shown in Table 4. (No further changes are requested in the FY 1969 authorizations, as revised in January 1969.)

The net change in New Obligational Authority is minus $141 million in FY 1969 and minus $3,103 million in FY 1970, for a total net reduction of about $3,244 million in the two years. The net change in the amounts requested for authorization in FY 1970 is minus $1,188 million.

Total Defense Department Outlays are now estimated at $78.4 billion in FY 1969 (the same as in the January budget) and $77.9 billion in FY 1970 ($1.1 billion less than in the January budget). I should point out, however, that our review to date has already revealed a deficit of several hundred million dollars in the Navy shipbuilding and conversion program, and additional deficits in other major programs. I will have more to say on this later.

I should also point out that neither the original nor revised estimates of New Obligational Authority and Outlays include the cost of the pay increases which will go into effect under existing legislation. The total cost to the FY 1970 budget of the new pay increases already authorized under existing legislation is estimated at $2.5 billion—$1.8 billion for military and $0.7 billion for civilian personnel.

Provision for these pay increases has been made in the government-wide "Allowances for Contingencies" account.

One final point before turning to our proposed changes to the FY 1969 supplemental and the FY 1970 budget. As you know, President Nixon had not finally approved the government-wide budget changes as of the time I submitted this statement to you.

However, realizing the urgency of this Committee's time requirements, I requested and received permission to present the Defense Department changes to you in advance of final approval of the overall budget. Accordingly, I must point out that the requested program changes and figures, which I am discussing today, are subject to modification by the Bureau of the Budget and the President until the government-wide budget is finally approved.

Strategic Forces

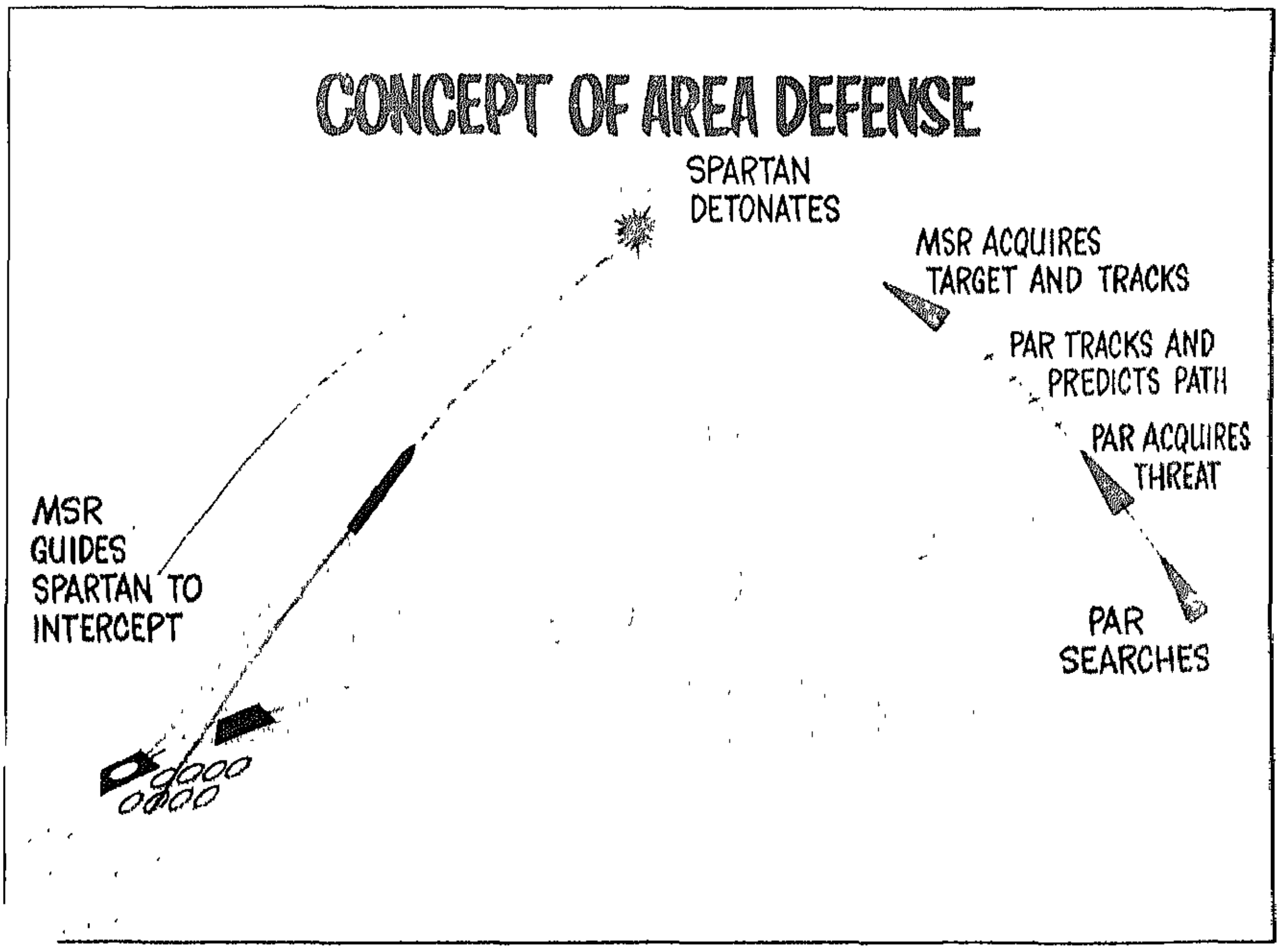
The first item on Table 1 is the Sentinel (now Safeguard) program. President Nixon on March 14 explained the reasons why we have reached the conclusion that we must go ahead with the development and deployment of a ballistic missile defense system. He pointed out that the system now being proposed is based on a different concept than the Sentinel system approved by the preceding Administration. The modified anti-ballistic missile (ABM) system has been designed so that its defensive intent is unmistakable. Moreover, it will be deployed in a manner clearly related to the emerging threat, rather than on the basis of some fixed schedule based on theoretical assumptions.

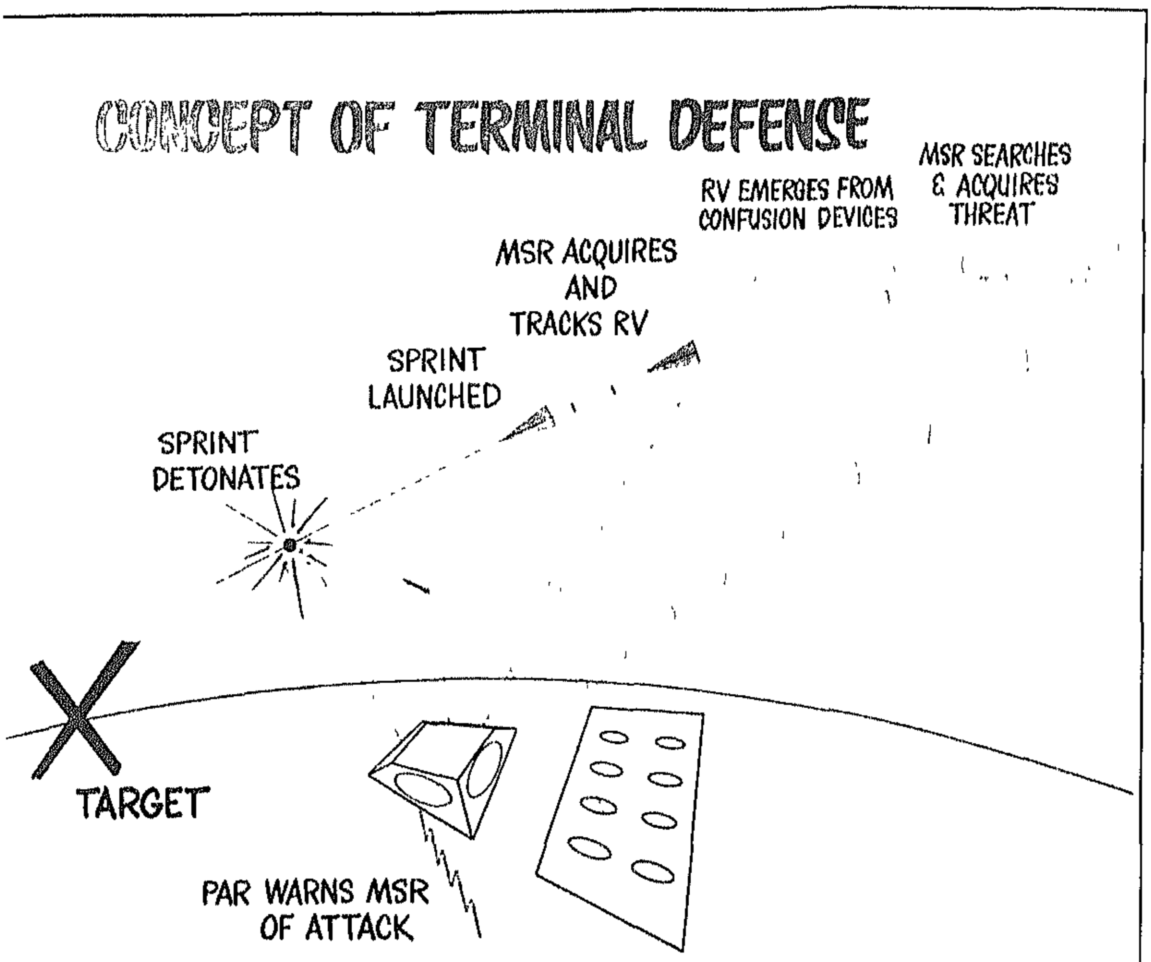
In reviewing this program, we examined all of the major alternatives:

- A deployment which would defend U.S. cities against a Soviet attack.
- No deployment at all, but a continuation of research and development.
- The continuation of the Sentinel program approved by the preceding Administration.
- The deployment of a modified system which would fulfill three objectives: defense of our land-based strategic offensive forces against a first strike by the Soviet Union; protection of the American people against the kind of nuclear attack which Communist China is likely to be able to mount within the decade; and defense of the nation against an accidental or small attack from any source.

Alternative 1.

We rejected the first alternative, not because we do not want to provide complete protection for the American people against a major Soviet attack, but rather because it is not now in our power to do so. The heaviest defense system we considered in our review, one designed to protect our major cities, could still not prevent a catastrophic level of U.S. fatalities





...f a deliberate all-out ... And, such a deploy-...ok like the prelude to ... strategy designed to ...viet deterrent.

... the second alternative ...t) because it left us ... to provide defense for ... on the schedule that ...uired by the Soviet ...o not reach an agree-... Soviets on limiting .... The Soviet Union is ... offensive forces at a ...aster rate than was ...967, when the decision ...el was made.

... recall, former Secre-... Clark Clifford, in his ...nt in January, pointed ...eriod of a little more ...s the Soviets had in-...umber of operational ...s more than threefold, ...d-1966 to 896 by Sept. 1, 1968. As of today, the Soviets have in-being and under construction more ICBM launchers than the 1,018 possessed by the United States.

Moreover, the Chinese threat against our population, as well as the danger of an accidental or small attack from some other source, cannot be ignored. Since it is within our power to reduce U.S. fatalities to a minimum level, or to prevent them altogether in the event of Chinese attacks or small attacks from other nations, we must act to do so.

Alternative 3.

We rejected the third alternative (deployment of the Sentinel system approved by the preceding Administration) because it would not provide sufficient protection against the emerging Soviet threat to our strategic offensive forces. These emerging threats include the rapid buildup in the Soviet submarine-launched ballistic missile (SLBM) force, their development of a Fractional Orbit Bombardment System (FOBS), and their likely deployment of large ICBMs with multiple warheads. Also, the original Sentinel plan could be misinterpreted as—and could, in fact, have been—a first step towards the construction of a heavy system for the defense of our cities.

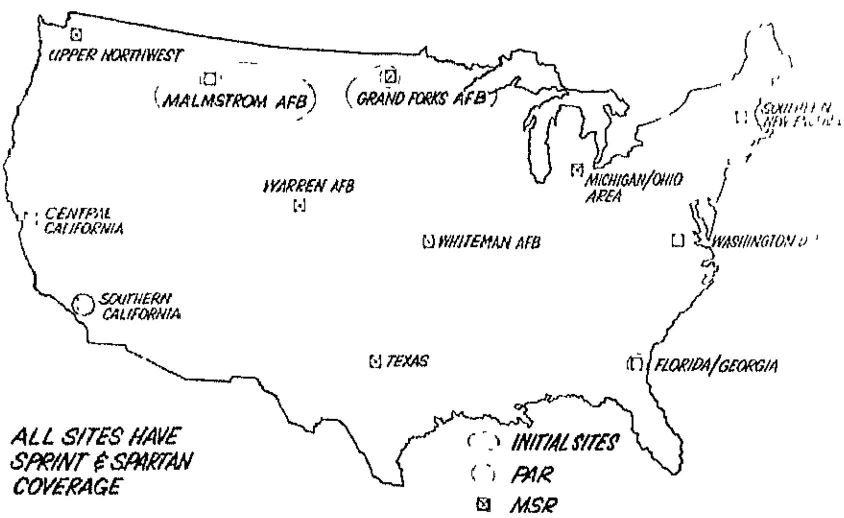
Alternative 4.

I believe we can all agree that our nuclear deterrent must be made as secure as is technically and economically feasible. Our nuclear forces defend not only ourselves, but our allies. Accordingly, we must take whatever steps are practicable to ensure that our strategic retaliatory forces can survive a Soviet attack.

After examining the available alternatives, we have concluded that a combination of approaches provides the most realistic means of safeguarding our retaliatory capability.

This combination consists of beginning a measured deployment of an active defense of our retaliatory

MODIFIED SENTINEL



forces, structured to expand as circumstances may dictate, and preserving the option, if we later find it necessary, to harden further our land-based missiles. The combination is necessary because our studies show that hardening alone would not provide adequate protection against foreseeable advances in the accuracy of Soviet missiles.

The ABM defense system we now propose to deploy will use components previously developed for Sentinel. However, these components will be deployed in such a way as to provide:

• A local defense of the Minuteman missile silos.

• Early warning and area defense of our bomber bases and command and control system.

• A defense of the continental United States against the kind of attack which the Chinese Communists may be able to launch in the mid-1970s.

• Protection against an accidental or small attack from any source.

This system will not require the emplacement of missiles or radars in or near our major cities, except for the protection of the National Command Authorities in Washington, D. C.

Our current plan includes a total of 14 sites, compared with 17 sites in the previous plan. Twelve of the sites are in the continental United States. The other two, Alaska and Hawaii, have been included as an option. The Chicago, New York, and Salt Lake City sites have been eliminated. Thus far, only the first two sites—Grand Forks AFB, N.D., and Malmstrom AFB, Mont.—have been approved for deployment, each with one 4-face Missile Site Radar (MSR), one 1-face Perimeter Acquisition Radar (PAR), Standard Spartans and Sprints. The schedule on which the remaining sites will be deployed will be determined year by year in step with the emergence of the threat.

The new system, if fully deployed (not including the option for Alaska and Hawaii), would provide 12 MSRs with 48 faces instead of 17 MSRs with 38 faces; and 7 PARs with 11 faces instead of 6 PARs with 6 faces. The increase in PAR capability is required to provide all-around radar coverage of the United States, including the seaward approaches. The latter is particularly important for the defense of our deterrent forces against the Soviet SLBM threat. Our present early warning systems do not provide adequate coverage of the seaward approaches and our alert bombers may be caught on their bases by a surprise SLBM attack. Furthermore, the Soviets may configure their SLBMs for depressed trajectory launch. In that case, the total time to target might be considerably less than the 15 minutes required for a normal high trajectory launch. Since our alert bomber forces require 15 minutes from warning to get off their bases, we must also be able to intercept at least the first salvo of SLBMs, and this the proposed new system is designed to do.

An improved, longer-range Spartan is now under development. If we later find that this missile promises sufficient advantage to warrant proceeding further, we will substitute some Improved Spartans for the Standard Spartan. The longer-range Spartan would give us better coverage of the entire continental United States.

All of the ABM sites would be equipped with some Sprints. The four sites to be located in the Minuteman fields (Grand Forks AFB, N.D.; Malmstrom AFB, Mont.; Whiteman AFB, Mo.; and Warren AFB, Wyo.) would have a considerably larger number than the others.

In summary, the proposed system would work as follows:

• The Spartan batteries at each of the 12 locations would provide area protection against the early Chinese Communist ICBM threat.

• The PARs would provide surveillance and tracking against ICBMs, FOBS and SLBMs.

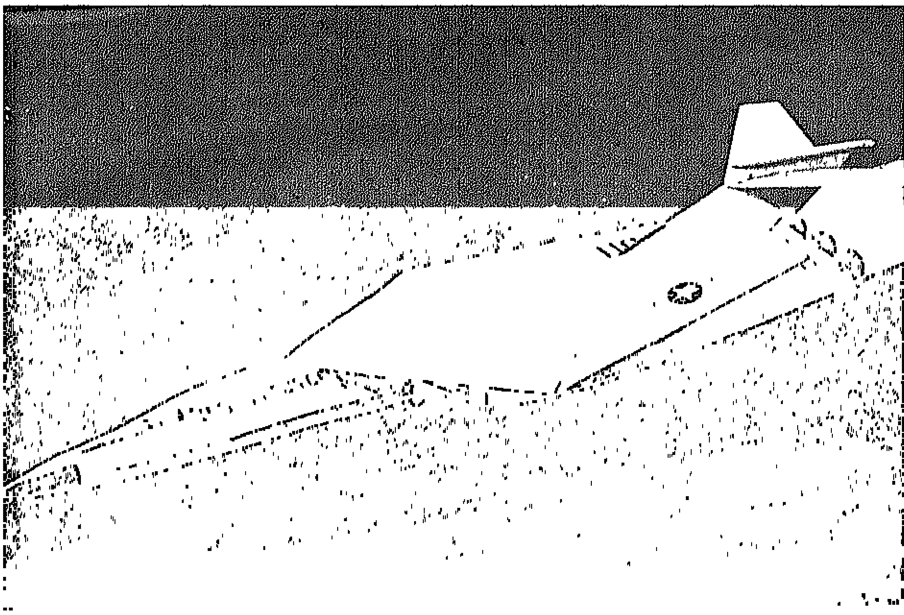
• The PARs and MSRs would give extra warning, and the Spartans and Sprints some extra protection to the alert bomber force.

• The system as a whole would protect the ABM sites, themselves, and some of the bomber bases against a FOBS attack.

• The four ABM sites, located in the Minuteman fields, would provide some initial protection (and the option for additional protection) to a portion of our Minuteman force.

• The site at Washington, D. C., would give protection to the National Command Authorities against a moderately heavy attack.

The investment cost (procurement and construction) of the new system, if fully deployed, would range from \$6 billion to a little over \$7 billion, depending on the options that are exercised. This is somewhat more than the cost estimates of the Sentinel system proposed by the preceding Administration. The modified system, however, provides additional capabilities. Because the new system would be deployed at a much more deliberate pace, budgetary requirements in FY 1970 will be about one-half that proposed in the original budget—about \$900 million compared with about \$1.8 billion. As shown on Table 1, the total reduction in Obligational Authority for FY 1969–70



With an increase in funds for the AMSA design phase, engineering development should begin in FY 1970.

amounts to almost $1 billion. All but $3 million (for Operation and Maintenance) of this total can be applied to reduce the FY 1970 New Obligational Authority required.

The next item, a reduction of $34 million in Nike-X Advanced Development, reflects a deferral of work on a new type of radar. This is a lower priority effort which will just have to be delayed another year to help reduce FY 1970 expenditures.

The third item on Table 1 is the FB-111. As you are well aware, the choice of this aircraft as a strategic bomber was subject to question from the very beginning of the program. Now, more than three years after the decision was made to produce and deploy the FB-111, we find that both the aircraft and its Short Range Attack Missile (SRAM) are still experiencing development and production difficulties, and the cost per aircraft continues to mount. Three years ago the investment cost for a force of 14 operational squadrons (210 unit equipment aircraft) was estimated at $1.9 billion, excluding SRAM. Last January, for reasons explained by Secretary Clifford in his FY 1970 posture statement, the decision was made to reduce the program to 6 operational squadrons (90 unit equipment) with an estimated cost of $1.8 billion, excluding SRAM.

In other words, revised estimates by the previous Administration show that 6 squadrons of FB-111s would cost approximately the same as the cost of 14 squadrons under original estimates.

Now, after a very careful review of the program, we have decided to cut off the FB-111 program at four squadrons (to salvage what we can of the work in process) and concentrate our efforts on the development of a new strategic bomber, the Advanced Manned Strategic Aircraft (AMSA). The FB-111 will not meet the requirements for a true intercontinental bomber, and the cost per unit has reached a point where an AMSA must be considered to fill the void.

Accordingly, the FY 1969 buy of FB-111s can be reduced (with a saving of $107 million), and the planned FY 1970 buy can be eliminated altogether (with a saving of $321 million). The first squadrons of FB-111s will be delivered on the same schedule as planned in the original FY 1970 budget.

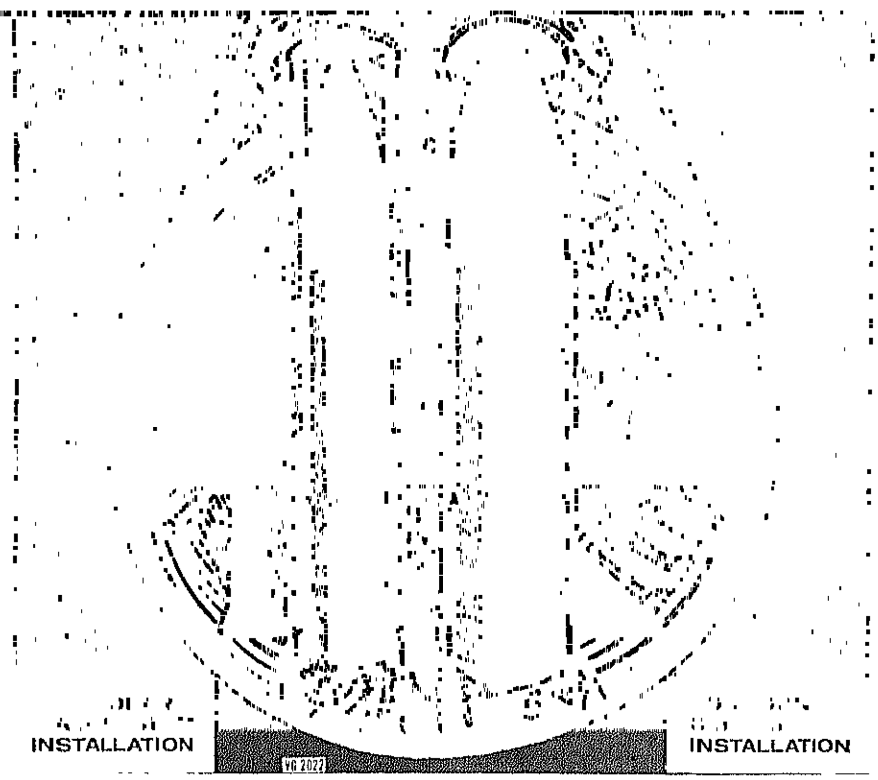
With regard to AMSA, the original FY 1970 budget provided a total of $77.2 million to continue the competitive design phase (*i.e.*, engineering drawings, wind tunnel testing, and mockups) initiated with FY 1969 funds, and to advance the development of the long lead-time avionics and propulsion systems. We now propose to increase that amount by $23 million to shorten the competitive design phase and permit the start of full scale engineering development in FY 1970. With the new design proposals in hand, we should be able to resolve, once and for all, the long-standing controversy over the configuration of AMSA. While no decision on production and deployment need be made now, the accelerated research and development effort could advance the initial operational capability (IOC) of this aircraft by one year, from 1978 to 1977.

The net reduction of $326 million shown for SRAM is the aggregate of four changes—three reductions and one addition. All of these changes are related to the difficulties encountered in the development of SRAM. We have now reached the conclusion that procurement of operational missiles should be deferred until the test program conclusively demonstrates that they will work as intended.

Accordingly, we have deleted most of the missile procurement funds from the budget ($42.2 million in FY 1969 and $110.8 in FY 1970, for a total of $153 million). Inasmuch as we do not know when operational missiles will be available, we have also deferred all special SRAM modification work on the B-52 and FB-111s. The reduction in B-52 SRAM modifications amounts to $37.7 million in FY 1969 and $102.6 million in FY 1970, for a total of $140.3 million. The reduction in FB-111 SRAM modifications amounts to $49.7 million in FY 1969. (As I noted earlier, the last procurement of FB-111s will be made in FY 1969.) Because procurement of the SRAM missile has been deferred beyond FY 1970, the research and development program will have to absorb a greater portion of the overhead cost. Therefore, $17 million has been added to the FY 1970 program for this purpose.

The reduction in Minuteman funding of about $160 million in FY 1970, shown on Table 1, is the aggregate of three separate changes.

The first, and most important, is a slowdown in the development of Minuteman III. While we are confident that the Minuteman III will perform as intended, we believe it would be prudent to reduce somewhat the previously planned deployment rate, at least through the FY 1970 procurement lead time. This delay would serve to reduce the amount of overlapping of research and development and production, and provide more time for testing. In connection with



An increase of $12.4 million is requested for development of an improved guidance system for the Poseidon missile.

the latter, we plan to accelerate the beginning of operational testing by about two months to help ensure that the missile is working well before we return to the originally planned rate in FY 1971. This reflects our determination to minimize cost overruns resulting from research and development modifications after production has commenced. By continuing the originally planned rate through FY 1972 and FY 1973, we could be back on the previous deployment schedule by the end of FY 1974.

Accordingly, we plan to hold Minuteman III production at a lower rate through the FY 1970 funding period, increasing to a higher rate in FY 1971 if all goes well. This will permit a reduction of $135 million in the FY 1970 budget request.

To compensate for the slower deployment of Minuteman IIIs, additional numbers of Minuteman I will be retained in the force. Consequently, the last of the Minuteman I force will be phased out in FY 1974, instead of FY 1973. The Minuteman II deployment plan is unchanged.

The second adjustment concerns the rate of development of the Minuteman Integrated Command and Control System (MICCS). The principal purpose of this system is the integration of Minuteman and ABM command and control. Inasmuch as the ABM program has been modified, the scheduled development of the MICCS can be stretched out. We propose, therefore, to reduce the FY 1970 program by $16 million, from $36 million to $20 million.

The third adjustment is related to some minor construction work at 200 Minuteman silos. About $6 million was included in the original FY 1970 budget to correct potential electrical system and water seepage problems at those silos, because similar problems had been encountered elsewhere in the force. Tests conducted at two of these silos (subsequent to the submission of the FY 1970 budget) indicates that these problems have not materialized and that the work is no longer required.

The increase of $12.4 million for the development of an improved guidance system for the Poseidon missile will advance the initial operating capability (IOC) of that system by about six months. This development was started in FY 1968. The IOC, however, was slipped by about one year in connection with the FY 1969 expenditure reduction effort, and the level of funding provided in the original FY 1970 budget ($33.5 million) would have slipped it further. This is an important program since it promises to improve significantly the accuracy of the Poseidon missile, thus expand the coverage of the system. This expanded coverage is particularly important in relation to the Soviet SLBM threat.

The reduction of $15 million shown for the Airborne Warning and Control System (AWACS) represents a modest stretch out of this air defense program, particularly with regard to the initiation of engineering development. About $40 million is available for this program in FY 1969 and an additional $75 million was included in the original FY 1970 budget. The reduction of $15 million would thus leave $60 million for FY 1970, which should be enough to keep the program moving at an acceptable level until actual flight tests have demonstrated a usable radar detection and tracking system.

Southeast Asia Items

The next group of items shown on Table 1 is related to the conflict in Southeast Asia.

The increase of $25 million in FY 1969 and $77 million in FY 1970, requested for B-52 sorties, is required to support the additional flying time associated with the maintenance of the current high monthly rate through June 1970. The original FY 1970 budget was based on a lesser number of sorties per month beginning in January 1969. We have actually been flying the current high rate since March 1968, and General Abrams has strongly recommended that this rate be continued. As you know, he considers the B-52 to be one

t important weapons. As would like to support his ıtion, the budget stringen- which we must operate will not permit a contin- at rate beyond June 1969; his extension will require of $25.1 million in FY ›ver, we have found that FY 1970 budget did not ficient funds to maintain 'educed rate through 30 and another $27.4 million uired for this purpose. I trongly that we must be port at least this reduced 52 sorties throughout the ear.

, item has to do with nitions. To be perfectly nk the consumption rates ast Asia are based on ıistic assumptions, partic- 'iew of the current Tet s you will see, however, ›ing production at a very throughout CY 1969. Congress approve the re- n about to discuss, I as- mmittee that I will keep ch on actual consumption get further into the year.

million reduction shown for ground munitions re- ecent downward trend in in Southeast Asia. The 1970 budget projected at 105,000 tons per ıgh December 1970. Con- January of this year was and the assumption is t will continue to decline xt year or so. For budget rposes, we have assumed ıption will average about ›er month during the July 1970 period, and then ',000 tons per month dur- ›ril 1970-December 1970

ı of ground ammunition ing at about 145,000 tons and we plan to maintain .hrough December 1969. n January 1970—if the stimates of consumption ıt, we plan to reduce pro- about 75,000 tons per maintain that rate :ember 1970 (the end of procurement lead time). ted consumption will ex- l production in CY 1970, our world-wide inventory of ground munitions is expected to decline by about 160,000 tons by December 1970. However, the very substantial inventory we will have built up through December 1969 would provide an additional hedge should ground ammunition consumption suddenly increase during the next year or so.

Since we are now projecting a decrease in ground ammunition consumption in FY 1970, we can also reduce the funds requested for the transportation of ammunition by about $34 million, as shown in the next item on Table 1.

The reductions shown for air munitions, $89.5 million in FY 1969 and $422.4 million in FY 1970, are based on a somewhat different premise than in the case of ground munitions. The original FY 1970 budget projected both consumption and production of air munitions at 110,000 tons per month from January 1969 through December 1970 (the end of the FY 1970 procurement lead time). Included in the projected consumption rate were the lower number of B-52 sorties.

Actual consumption is now running at about 130,000 tons per month (including the higher number of B-52 sorties), and we have maintained production at about that same rate. Since we see no indication that consumption will decline during the next 12-18 months, we believe it would be prudent to maintain production at about a rate of 125,000 tons per month, at least through June 1970. At that point our world-wide inventory would be very substantial, when taken together with a "hot" production base. Accordingly, we believe we can plan on reducing air munitions production, beginning in July 1970, to the lowest sustaining rate—about 50,000 tons per month—from which we can readily expand it to the present rate within a period of 4-6 months.

The next item, a reduction of about $30 million in FY 1969 and $47 million in FY 1970 for ship gun ammunition and related items, is based on a drop in Southeast Asia consumption below the level projected in the original FY 1970 budget. Consumption in November and December 1968 averaged about 2,600 tons per month, and that rate was projected through the FY 1970 procurement lead time. Since December, consumption has declined to about that same rate per month, which is the rate we now project through December 1970. To provide a margin of safety, we plan to reduce the production of ship gun ammunition to about 2,100 tons per month in CY 1970, with a savings of about $44 million. The remaining $3 million in this item reflects a reduction in the FY 1970 procurement of ship gun barrels. The lower rate of ammunition consumption will also result in a slower rate of wear-out for gun barrels.

The next item on Table 1, Defense Communications Planning Group, involves the special anti-infiltration system initiated by former Secretary of Defense McNamara in 1967, under the code name Dye Marker/Muscle Shoals. The original plan did not work out as expected and, as a result, important reductions have occurred in the requirements for this system. The original FY 1969 budget, approved by the Congress last year, had by December 1968 already gone through a number of revisions. The original total of about $691 million was reduced to $579 million. The principal decreases were in munitions, offset in large part by increases in sensors.

The reduction we now propose, $54.6 million in FY 1969, again consists mostly of munitions and related items. However, $11 million represents a reduction in the procurement of sensors which can be made available from existing stocks. With these reductions, the revised FY 1969 pr gram now stands at about $524 m lion, about $167 million less than t original budget approved by the C gress.

The $95 million reduction in r craft and spares ($6.8 million in 1969 and $88.1 million in FY 1970) the aggregate of four decreases one increase. Because combat at tion in Southeast Asia has been ru ning below the levels projected, v can eliminate the planned FY 19 buy of CH-53D heavy transpo helicopters (with a saving of abo $73 million), and reduce the CH-46 medium transport helicopter b (with a saving of $20 million). T third FY 1970 reduction is related the halt in the bombing of Nor Vietnam. The DASH anti-submari warfare drone helicopters, whi were to be converted to reconnai sance vehicles in FY 1970, are r

longer needed and the entire program of 30 drones can be deleted, with a saving of $8 million. The $6.8 million reduction in FY 1969, shown on Table 1, simply reflects a change in the estimated unit cost of 28 so-called "quiet aircraft" included in the Air Force supplemental aircraft program.

Combat attrition for the UH-1E, the single engine Huey used by the Marine Corps in Southeast Asia, has been running higher than projected. Therefore, to maintain the inventory, $13 million is being requested in the FY 1970 budget to procure the UH-1N, a twin engine Huey.

The next item on Table 1 involves modernization of the Republic of Vietnam Armed Forces (RVNAF) which I discussed in connection with *my report on Vietnam.*

The last entry in the Southeast Asia category, "Miscellaneous," is an aggregate of a number of reductions totaling about $46 million in FY 1969 and $86 million in FY 1970. . . .

Non-Southeast Asia General Purpose Forces

Summarized in the next category shown on Table 1 are the changes we propose in the non-Southeast Asia General Purpose Forces programs. The first item is the F-111D. Because of the cutback in the FB-111 program, changes will have to be made in both the FB-111 and F-111 production schedules. After the last of the FB-111s are delivered in December 1970, we plan to hold F-111 production to the minimum sustaining rate. To do so, we will have to buy an additional quantity of tactical F-111s in FY 1970. The increases in funds shown on Table 1 reflect these adjustments in the production schedules. The total number of tactical F-111s to be procured for the U.S. Air Force is the same as previously planned. In addition, 24 F-111Cs are being produced for sale to the Australian Air Force.

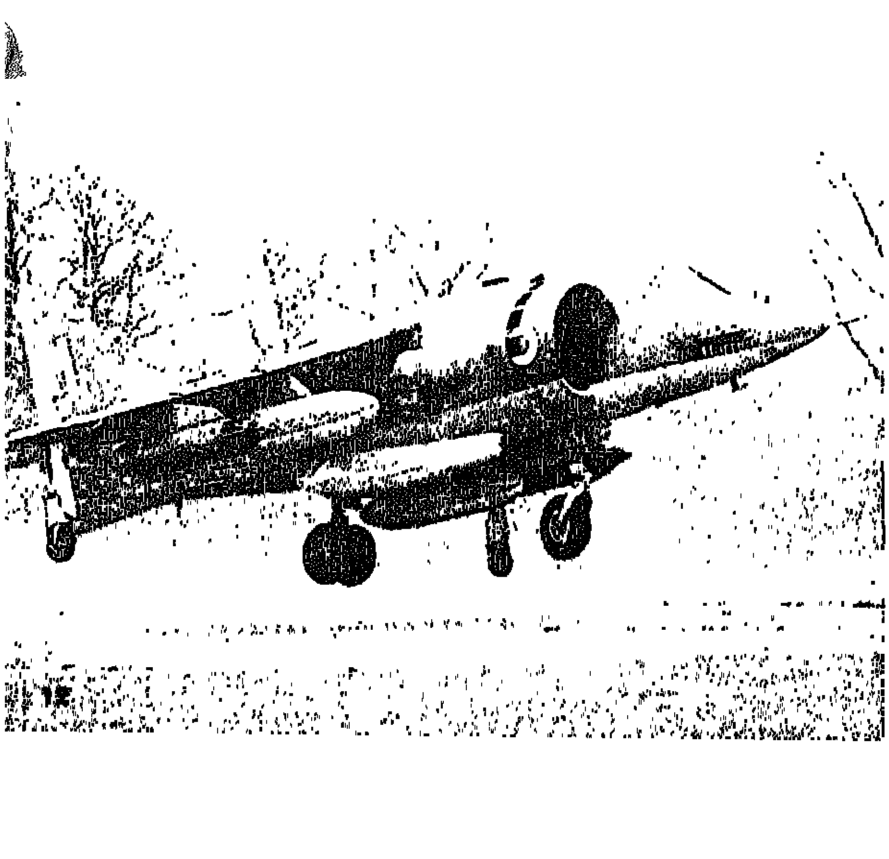
In reviewing the FY 1970 budget, we found that the production schedule for the EA-6B aircraft was out of phase with the production schedule for its ground support equipment. Apparently, the continually rising cost of the aircraft absorbed some of the funds intended for the ground equipment, leaving only enough to provide ground support for a limited number of aircraft through the FY 1970 lead time. Inasmuch as the lead time for ground support equipment is considerably longer than for the aircraft itself, the only practical way in which we can bring the two into proper balance is to reschedule the aircraft procurement program. We still plan to buy the same total number of EA-6Bs, but we will now buy them over a three-year period instead of a two-year period. The net effect is a reduction of $67.5 million in FY 1970.

The next two items, Harrier and F-4J, represent an even cost tradeoff. The Marine Corps is very anxious to acquire a V/STOL fighter aircraft, which would be much less dependent on fixed air bases and which could be used for both close air support and air defense. The United Kingdom has been working on such an aircraft, the Harrier, for some years. Flight testing has been completed and deliveries are now being made to the Royal Air Force. The Marine Corps has requested $57.6 million for the procurement of an initial buy of 12 Harriers in FY 1970, to be used for service testing and the development of tactical doctrine. In exchange, they are willing to give up the procurement of $57.6 million worth of F-4s in FY 1970, reducing the total buy in that year by about one-third.

The $2.9 million increase shown for Miscellaneous Aircraft Procurement is the net of three minor adjustments.

The next category of changes concerns the Navy Shipbuilding Program. This program is in urgent need of a much more comprehensive review than we have thus far had time to give it. Not only have serious cost overruns been encountered, but the longer-range program needs to be restructured. The Defense Department has for some years been pushing the fleet modernization problem into the future. The FY 1970-74 program, while quite reasonable in its parts, does not appear to be very practical as a whole. It peaks at a very high level in FY 1971 and then declines to a relatively low level by FY 1974. We plan to study both this and the cost overrun problem in greater detail in the months ahead. Our review to date has been primarily concerned with the FY 1970 and prior year shipbuilding programs. The changes we now propose are shown in Table 1. We are recommending some cancellations and some changes in the programs to be able to fund some of the overruns in the FY 1969 and FY 1970 budgets. I again would like to

The British Harrier, a VTOL supersonic fighter, is proposed for procurement for the Marine Corps in exchange for the F-4J previously requested in FY 1970 budget.



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963 class destroyer (formerly the DX) will also have a gas turbine propulsion system, there is no longer any need to build that destroyer escort. The destroyer tender and submarine tender were both planned to replace existing ships. Since the two existing ships can be continued in service longer if necessary, the two new ships can be eliminated.

To provide the $167 million of additional funds required in FY 1970, the Navy proposes the next four reductions shown on Table 1. The first would involve the cancellation of two of the three guided missile frigate (DLG) conversions planned for FY 1970, and a decrease of $10 million in advance procurement funds for the next four ships to be converted in FY 1971, for a total reduction of $76 million. The second would eliminate the $7 million in advance procurement funds requested in the FY 1970 budget for 10 ocean minesweepers (MSO) to be converted in FY 1971. The third would reduce the FY 1970 buy of P-3 anti-submarine warfare patrol aircraft by $15 million. The fourth would involve a large number of relatively small reductions in the FY 1970 Other Procurement, Navy, appropriation request.

These four reductions total $172 million. However, $5 million will have to be added to the Navy FY 1970 Operation and Maintenance request to overhaul the two guided missile frigates in lieu of conversion. Thus, the net reduction in these five items is $167 million.

Some of these reductions proposed by the Navy are simply deferrals, but others represent changes in requirements. I recognize that this is not a very good way to manage the shipbuilding program. However, we must begin to get this program under better control, and the first step is to hold the managers to their estimates. This will provide them with the needed incentive to either manage the program more efficiently or come up with more realistic estimates. I was surprised to find that one claim for additional reimbursements on a $159 million contract for 14 DE-1052 class destroyer escorts, funded in FY 1964-65, was recently settled for $96.5 million, an increase of almost two-thirds. That claim was based on design changes made by the Navy after the contract was negotiated and on delays in the delivery of government-furnished equipment. Two other firms building this same class ship have also filed claims for the same reasons—one for $120 million on 27 ships and the other $37 million on five ships—but these claims have not yet been settled.

The cost overrun problem is a particularly thorny one. When I discovered the extensive cost overruns in the shipbuilding program, I immediately ordered a check for overruns in other programs. Based on my initial investigation, we found a total of between $1 and $1.2 billion in other cost overruns. This includes, for example, the Army's Cheyenne program, the Air Force's C-5 and F-111 A/E/D programs, and additional overruns in the Navy's programs other than shipbuilding.

I am not at all confident that every overrun problem has been identified to date. Consequently, I intend to continue looking into this problem in connection with our comprehensive review, and will report back to the Congress any additional deficits we uncover. I sincerely hope I will find no more, since the $1.7-$1.8 billion we have already uncovered means that we must fund this deficit without being able to show any additional defense capability as a result of the outlay.

The small reductions shown for Other Miscellaneous Procurement on Table 1 are the net result of adjustments in a number of different procurement programs. Included among the increases in FY 1970 are $30 million for classified projects and $9 million for Navy E-2C aircraft avionics test equipment. The FY 1970 decreases include $14.2 million for self-contained, transportable medical units, $5 million for Air Force vehicles, $10 million for Air Force traffic control radars, and $11 million for Sparrow missiles (Air Force and Navy), $15 million for classified projects, and $4 for computers. The FY 1969 reduction of $3.4 million is in the Pershing modification program.

Two changes in the Military Construction program deserve special
mention. The first is
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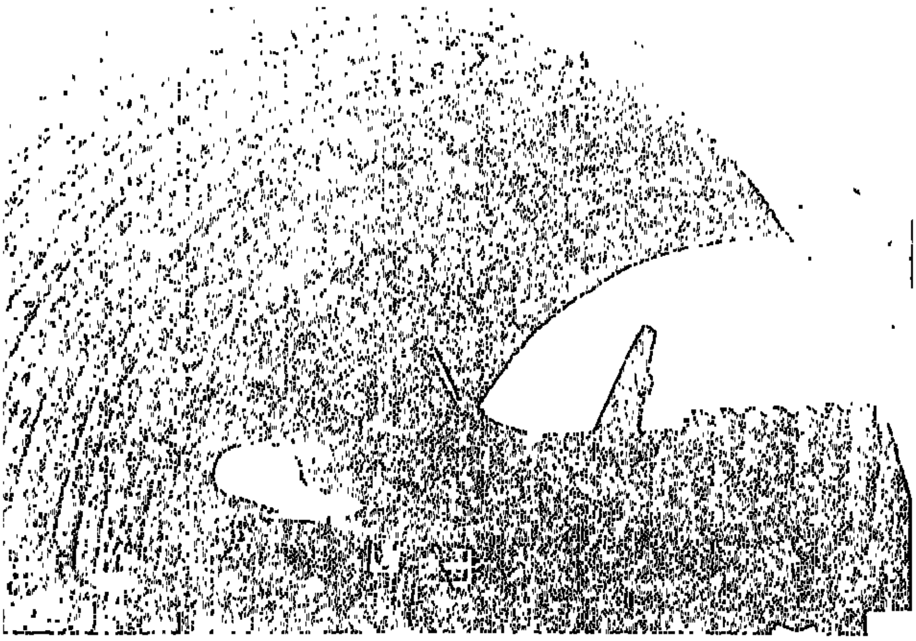


Additional funds are being requested for construction of aircraft shelters to further accelerate the program for protection of U. S. aircraft on European bases.

celerate the aircraft shelter program in Europe. Some $33 million was transferred from the Military Construction Contingency Fund to the Air Force for this purpose. With this transfer the program now totals $66 million, sufficient for 342 aircraft shelters and related support facilities.

Considering the concentration of U.S. aircraft on European bases, I believe that program should be further accelerated. The additional $14.7 million will provide 36 more aircraft shelters and essentially complete the dispersal pavements, POL storage, communications and navigation aids hardening, and the security facilities needed at the European bases.

The second change, a reduction of $16 million in FY 1970, reflects an agreement reached with our NATO partners in January 1969 to reimburse the United States, up to an amount of $96 million, for the cost of relocating our forces from France. Reimbursements will be made at the rate of $16 million a year. The first annual installment will be applied to our share of the FY 1970 NATO Infrastructure program, thus reducing the New Obligational Authority (NOA) required by an equal amount.

The $8.4 million increase in FY 1970 for other Military Construction projects is the net result of relatively small adjustments in a number of separate projects.

The next item, a reduction of $26 million in FY 1970, reflects the inactivation of a number of naval vessels (8 DD/DEs, 4 DERs, 1 AE, 2 APBs, 2 SS and 1 AF) and a reduction in Navy support. These are all lower priority forces and their deletion should not have any significantly adverse impact on the Navy's overall combat capabilities....

The next heading, Military Personnel and Operation and Maintenance, with two exceptions, encompasses a large number of relatively small adjustments.

The first exception is a reduction of $70 million for civilian personnel....

The second exception is REDCOSTE—the Defense Department's program to reduce military expenditures in Europe wherever this could be done without adversely affecting combat readiness. The original FY 1970 budget anticipated savings of about $160 million from this effort. We have reexamined the impact of the FY 1970 REDCOSTE program and are convinced it is somewhat too ambitious in the time frame contemplated. The Army and Air Force in particular cannot implement the program on the schedule originally planned. Accordingly, we propose to restore $17 million of the $56 million deleted from the Army budget under REDCOSTE, and $19 million of the $88 million deleted from the Air Force budget.

Airlift and Sealift Forces

The next major category, Airlift and Sealift Forces, involves two changes in FY 1970—an increase of $54.4 million for the procurement of more C–130Es, and an increase of $13.8 million for the retention of certain Air Force Reserve Component units.

Last fall, the Defense Department decided to buy 36 more C–130s (18 with FY 1968 funds specifically appropriated by the Congress for this purpose and 18 through the reprogramming of FY 1969 funds) because of higher-than-expected attrition on this aircraft in Vietnam. The C–130s we now propose to add to the program are to replace the C–7s and C–123s expected to be lost in Vietnam, and to offset the eventual transfer of C–123s to the South Vietnamese Air Force. This transfer is part of the Phase II force modernization I spoke about earlier. Without replacement, this loss of C–123s and C–7s would reduce our tactical airlift capabilities below the level I believe is needed.

With regard to the Air Force Reserve Components item, the original FY 1970 budget provided for the conversion of four C–119 Air Force Reserve units to other missions, but no decision had been made on what those other missions would be. We have now reviewed the mission requirements for these four units and have concluded that two should be converted to AC–119 gunships, one to tactical air support, and one to tactical air support combat crew training.

The original FY 1970 budget also provided for the inactivation of five Air National Guard air defense unit and the conversion of two airlift units to other, unspecified missions. We have now decided to convert all seven of these Air National Guard units to other missions as follows: one tactical air support, two air refueling, two C–141 associate, one F–100 tactical fighter, and one F–100 combat crew training.

Most of the increase for the Air Force Reserve Components, $10.8 mi

Funds in the amount of $54.4 million are being requested to increase procurement of C–130E aircraft.

lion, is for Operation and Maintenance. The balance of the increase, $3 million, is for Military Personnel and will involve an increase of about 2,400 drill pay spaces at end FY 1970.

Other Research and Development

I have already discussed a number of research and development changes in connection with other major categories, particularly Strategic Forces. The next major category, Other Research and Development, includes four items which have not yet been discussed.

The first, a reduction of $5 million in the Heavy Lift Helicopter (HLH) project (from $20 million to $15 million), would involve a three-month delay in contract definition for this new helicopter, which is being developed as a replacement for the CH–54. Since we have not yet decided whether to go ahead with full-scale development of the HLH, this small delay is acceptable.

The next item is a reduction of $51 million in the Manned Orbiting Laboratory (MOL). The original FY 1970 budget included $576 million for this program. That amount would have provided for seven launches. A careful review of the work done to date has convinced us that six launches would probably be enough to accomplish all of the approved objectives. The elimination of one launch will save $20 million. The remaining reduction of $31 million will simply stretch out the program and delay the first launch by two or three months.

The third item is an increase of $7.9 million for a special Infrared Technology project. The original FY 1970 budget included only $5 million for this purpose. I believe a greater effort on this project would be a worthwhile investment.

The final item in this category is a $50 million increase in the Emergency Fund. Last year, the Defense Department requested $125 million for this purpose; the Congress provided only $50 million (plus the usual $150 million in transfer authority). As a result, the preceding Administration requested only $50 million for FY 1970.

I am, of course, aware of the reasons why the Congress reduced the FY 1969 appropriation for the Emergency Fund to only $50 million. However, I am also aware of the urgent need for some degree of flexibility in the management of the DOD research and development effort. In a program of this kind, we cannot, some 18 months in advance of the end of the fiscal year, anticipate all of the requirements in detail. Unless we have an uncommitted reserve of funds, the only way we can meet emergency research and development problems during the year is to continually rejuggle the entire program. This is obviously undesirable from a management point of view. Accordingly, we are requesting an increase of $50 million in the FY 1970 Emergency Fund, to a total of $100 million. I will see to it that this fund is used only for the purposes intended by the Congress, namely, to meet unanticipated high priority requirements. Any balance remaining unused at the end of the fiscal year will be returned to the Treasury, and will not be applied to less urgent requirements simply because the funds are available.

The $18 million in Miscellaneous Research and Development reductions includes $10 million for a classified project, $5 million for the Deep Submergence Search Vehicle program (rdeucing the degree of currency in the development of components) and $3 million for ocean exploration.

The last item on Table 1 involves a reduction in the estimated Budget Authority required by the Homeowners Assistance Fund in FY 1969–70. Obligations are now expected to be $10 million lower in FY 1969 and $7 million lower in FY 1970 than previously estimated. Accordingly, the $1.8 million in New Obligational Authority requested for FY 1970 will not be required.

Table 1 **Department of Defense**

SUMMARY OF PROPOSED ADJUSTMENTS TO THE FY 1969 SUPPLEMENTAL AND FY 1970 BUDGET

(MILLIONS OF DOLLARS)

	Total Obligational Authority		
	FY 1969	FY 1970	FY 69–70
STRATEGIC FORCES			
Sentinel ABM	–101.0	–896.0	–997.0
Nike–X Advanced Development		–34.0	–34.0
FB–111	–107.3	–320.9	–428.2
Advanced Manned Strategic Aircraft		+23.0	+23.0
SRAM	–126.6	–196.4	–323.0
Procurement	(–42.2)	(–110.8)	(–153.0)
B–52	(–37.7)	(–102.6)	(–140.3)
FB–111	(–49.7)		(–49.7)
Research and Development		(+17.0)	(+17.0)
Minuteman III		–156.9	–156.9
Improved Guidance System (Poseidon)		+12.4	+12.4
Satellite Early Warning		+43.0	+43.0
AWACS		–15.0	–15.0
SOUTHEAST ASIA ITEMS			
B–52 Sorties	+25.1	+27.4	+52.5
Ground Munitions		–460.0	–460.0
Transportation (Ammunition)		–34.4	–34.4
Air Munitions	–89.5	–422.4	–511.9
Ship Gun Ammunition	–30.0	–47.1	–77.1
Defense Communications Planning Group	–54.6		–54.6
Aircraft and Spares	–6.8	–88.1	–94.9
RVNAF Modernization Phase II	+35.8	+120.3	+156.1
Production Base Support	(–75.0)[b]		(–75.0)[b]
Miscellaneous	–45.9	–86.0	–131.9
NON-SOUTHEAST ASIA GENERAL PURPOSE FORCES			
Aircraft Procurement			
F–111D	+11.5	+155.7	+167.2
EA–6B		–67.5	–67.5
Harrier		+57.6	+57.6
F–4J		–57.6	–57.6
Miscellaneous		+2.9	+2.9
Shipbuilding Program			
SSN (High Speed Submarine)		–105.5	–105.5
ATS Salvage Tugs		–45.3	–45.3
Claims and Cost Growth	+182.7[a]	+167.0	+349.7
DE Destroyer Escort (Gas Turbine)	(–41.6)[b]		(–41.6)[b]
AS Submarine Tender	–68.6		–68.6
AD Destroyer Tender	–72.5		–72.5
DLG Guided Missile Frigate Conversion		–76.0	–76.0
MSO Minesweeper Conversion		–7.1	–7.1
P–3 ASW Aircraft Procurement		–15.0	–15.0
Miscellaneous Navy Procurement		–73.9	–73.9
DLG Overhaul		+5.0	+5.0
Other Miscellaneous Procurement	–3.4	–24.6	–28.0
Military Construction			
Aircraft Shelters		+14.7	+14.7
NATO Infrastructure		(–16.0)[c]	(–16.0)[c]
Other	–0.1	+8.4	+8.3
Deletion of Lower Priority Forces		–26.0	–26.0
Military Personnel and Operation and Maintenance			
Civilian Personnel		–70.0	–70.0
Redcoste		+36.0	+36.0
Other	–11.2	–36.4	–47.6
FT AND SEALIFT FORCES			
		+54.4	+54.4
		+13.8	+13.8

Table 1 (Con't)

Department of Defense

SUMMARY OF PROPOSED ADJUSTMENTS TO THE FY 1969 SUPPLEMENTAL AND FY 1970 BUDGET

(MILLIONS OF DOLLARS)

	Total Obligational Authority		
	FY 1969	FY 1970	FY 69-70
OTHER RESEARCH AND DEVELOPMENT			
Heavy Lift Helicopter (HLH)		−5 0	−5.0
Manned Orbiting Laboratory		−51.0	−51 0
Infrared Technology		+7.9	+7 9
Emergency Fund		+50 0	+50.0
Miscellaneous		−18 0	−18 0
HOMEOWNERS ASSISTANCE FUND	−10 0	−7 0	−17.0
Net Reduction in Total Obligational Authority (TOA)	−625.9	−2,643.6	−3,269.5
Financial Adjustments[d]	+485 2	−459.5	+25.7
Net Reduction in New Obligational Authority (NOA)	−140 7	−3,103.1	−3,243.8

[a] $150.5 million of this amount is applicable to FY 1968 and prior years.

[b] This is a reduction in FY 1968 TOA.

[c] NOA only, TOA unchanged

[d] The FY 1969 financing adjustments are as follows: $108 9 million representing amounts to be reprogrammed to prior years and derived from reductions for Submarine Tender ($—68 6 million) and Destroyer Tender ($—72.5 million) partially offset by FY 1969 portion of shipbuilding "Claims and Cost Growth" ($+32 2 million), and $367.5 million increase in amounts carried over to finance FY 1970 programs derived from reductions in Sentinel ($—98.0 million), Air Force ammunition ($—108.6 million), ship gun ammunition ($—30.0 million), SRAM program ($—129 6 million), a Navy military construction project ($—0.1 million), and a Homeowners Assistance reduction, exclusive of the reductions in authorization to spend agency debt receipts ($—1.2).

The FY 1970 financing adjustments are as follows: The $367.5 million carry into the year as itemized above; $16 million applied to NATO Infrastructure to be provided through reimbursements from NATO allies, $76 million to be recouped from reduction in Army's FY 1968 production base support equipment, $7 4 million to be recouped from a FY 1968 project at the Boston Navy shipyard; offset by a $3.4 million reduction in Homeowners Assistance authorization to spend agency debt receipts and an increase to carry over to FY 1971 of $2.9 million.

Table 2

Department of Defense

SUMMARY—FY 1969 SUPPLEMENTAL BUDGET REVISIONS

(AMOUNTS IN THOUSAND DOLLARS)

Appropriation Title	1969 Supplemental Estimate	Recommended Change (+ or −)	Amended Estimate
Military Personnel			
Military Personnel, Army	491,000	−23,800	467,200
Military Personnel, Navy	224,000	−3,800	220,200
Military Personnel, Marine Corps	71,000	−9,500	61,500
Military Personnel, Air Force	418,000	−4,400	413,600
Reserve Personnel, Army	5,600	—	5,600
Reserve Personnel, Navy	8,500	—	8,500
Reserve Personnel, Marine Corps	9,900	−3,100	6,800
Reserve Personnel, Air Force	1,900	—	1,900
National Guard Personnel, Army	16,400	—	16,400
National Guard Personnel, Air Force	3,400	—	3,400
Retired Pay, Defense	175,000	—	175,000
Total—Military Personnel	1,424,700	−44,600	1,380,100
Operation and Maintenance			
Operation and Maintenance, Army	259,200	−7,800	251,400
Operation and Maintenance, Navy	26,100	—	26,100
Operation and Maintenance, Marine Corps	28,900	—	28,900
Operation and Maintenance, Air Force	373,400	+25,100	398,500
Operation and Maintenance, Defense Agencies	40,500	—	40,500
Operation and Maintenance, Army National Guard	13,000	—	13,000
Operation and Maintenance, Air National Guard	15,682	—	15,682
Court of Military Appeals, Defense	18	—	18
Total—Operation and Maintenance	756,800	+17,300	774,100
Procurement			
Procurement of Equipment & Missiles, Army	727,800	−10,800	717,000
Aircraft Procurement, Air Force	102,600	−102,600	—
Total—Procurement	830,400	−113,400	717,000
Total—Military Functions Supplemental NOA	3,011,900	−140,700	2,871,200

Table 3

Department of Defense
SUMMARY—FY 1970 BUDGET REVISIONS
(AMOUNTS IN THOUSAND DOLLARS)

Appropriation Title	1970 Budget Estimate	Recommended Change (+ or −)	Amended Estimate
Military Personnel			
Military Personnel, Army	8,535,000	+16,700	8,551,700
Military Personnel, Navy	4,526,000	−17,500	4,508,500
Military Personnel, Marine Corps	1,580,000	−3,000	1,577,000
Military Personnel, Air Force	5,959,000	−6,200	5,952,800
Reserve Personnel, Army	311,000	—	311,000
Reserve Personnel, Navy	139,700	+700	140,400
Reserve Personnel, Marine Corps	45,700	—	45,700
Reserve Personnel, Air Force	87,700	+500	88,200
National Guard Personnel, Army	363,500	—	363,500
National Guard Personnel, Air Force	101,600	+1,500	103,100
Retired Pay, Defense	2,735,000	—	2,735,000
Total—Military Personnel	24,384,200	−7,300	24,376,900
Operation and Maintenance			
Operation and Maintenance, Army	7,596,000	−91,500	7,504,500
Operation and Maintenance, Navy	5,383,000	−59,300	5,323,700
Operation and Maintenance, Marine Corps	457,000	—	457,000
Operation and Maintenance, Air Force	6,716,000	−4,300	6,711,700
Operation and Maintenance, Defense Agencies	1,098,000	−3,000	1,095,000
Operation and Maintenance, Army National Guard	306,000	—	306,000
Operation and Maintenance, Air National Guard	333,334	+9,200	342,534
Claims, Defense	41,000	—	41,000
Contingencies	10,000	—	10,000
Court of Military Appeals, Defense	666	—	666
Total—Operation and Maintenance	21,941,000	−148,900	21,792,100
Procurement			
Procurement of Equipment & Missiles, Army	5,933,000	−863,900	5,069,100
Procurement of Aircraft & Missiles, Navy	3,409,000	−173,500	3,235,500
Shipbuilding and Conversion, Navy	2,698,300	−66,900	2,631,400
Other Procurement, Navy	2,271,000	−248,300	2,022,700
Procurement, Marine Corps	650,600	—	650,600
Aircraft Procurement, Air Force	4,081,000	−305,800	3,775,200
Missile Procurement, Air Force	1,794,000	−307,600	1,486,400
Other Procurement, Air Force	2,320,000	−381,700	1,938,300
Procurement, Defense Agencies	84,000	−6,400	77,600
Total—Procurement	23,240,900	−2,354,100	20,886,800
Research, Development, Test, & Evaluation			
Research, Development, Test, & Evaluation, Army	1,822,500	+27,000	1,849,500
Research, Development, Test, & Evaluation, Navy	2,207,100	+4,400	2,211,500
Research, Development, Test, & Evaluation, Air Force	3,594,300	−33,100	3,561,200
Research, Development, Test, & Evaluation, Defense Agencies	500,200	—	500,200
Emergency Fund, Defense	50,000	+50,000	100,000
Total—Research, Development, Test, & Evaluation	8,174,100	+48,300	8,222,400
Military Construction			
Military Construction, Army	1,037,500	−641,900	395,600
Military Construction, Navy	398,400	−1,200	397,200
Military Construction, Air Force	385,300	+3,800	389,100
Military Construction, Defense Agencies	74,500	—	74,500
Military Construction, Army Reserve	10,000	—	10,000
Military Construction, Naval Reserve	9,600	—	9,600
Military Construction, Air Force Reserve	5,300	—	5,300
Military Construction, Army National Guard	15,000	—	15,000
Military Construction, Air National Guard	13,200	—	13,200
Total—Military Construction	1,948,800	−639,300	1,309,500
amily Housing			
Family Housing, Defense	607,800	—	607,800
Homeowners Assistance Fund, Defense	9,700	−1,850	7,850
Total—Family Housing	617,500	−1,850	615,650
vil Defense			
Operation and Maintenance, Civil Defense	50,700	—	50,700
Research Shelter Survey & Marking, CD	24,600	—	24,600
Total—Civil Defense	75,300	—	75,300
udget Concepts Adjustments			
Trust funds	7,429	—	7,429
Intragovernmental transactions	−7,200	—	−7,200
Applicable receipts	−144,507	—	−144,507
Total—Budget Concepts Adjustments	−144,278	—	−144,278
Grand Total—Military Functions, NOA	80,237,522	−3,103,150	77,134,372
Military Assistance			
Military Assistance, Executive	375,000	—	375,000
Foreign Military Credit Sales, Executive	275,000	—	275,000
MAP Trust fund	750,000	—	750,000
MAP Applicable Receipts	−992,325	—	−992,325
Total—Military Assistance	407,675	—	407,675
Total—Department of Defense, NOA	80,645,197	−3,103,150	77,542,047
Outlays			
Military Functions	78,471,000	−1,113,000	77,358,000
Military Assistance	529,000	—	529,000
Total—Department of Defense	79,000,000	−1,113,000	77,887,000

Table 4 Department of Defense

SOURCE OF FUNDS FOR AIRCRAFT, MISSILES, SHIPS AND TRACKED COMBAT VEHICLES FY 1970 PROCUREMENT PROGRAM

($ IN THOUSANDS)

	Total Amount of FY 1970 Program			Funding Available for Financing Program in Part	NOA Requested for Authorization		
	Original	Change	Revised		Original	Change	Revised
Aircraft							
Procurement of Equipment and Missiles, Army	941,500	—	941,500	—	941,500	—	941,500
Procurement of Aircraft and Missiles, Navy (and Marine Corps)	2,658,900	−159,700	2,499,200	90,000	2,568,900	−159,700	2,409,200 [1]
Aircraft Procurement, Air Force	4,556,000	−218,400	4,337,600	237,400	4,406,000	−305,800	4,100,200 [2]
Sub-total—Aircraft	8,156,400	−378,100	7,778,300	327,400	7,916,400	−465,500	7,450,900
Missiles							
Procurement of Equipment and Missiles, Army	1,347,660	−375,000	972,660	15,000	1,347,660	−390,000 [3]	957,600
Procurement of Aircraft and Missiles, Navy	865,100	−13,800	851,300	—	865,100	−13,800	851,300
Procurement, Marine Corps	20,100	—	20,100	—	20,100	—	20,100
Missile Procurement, Air Force	1,882,200	−265,400	1,616,800	130,400	1,794,000	−307,600	1,486,400
Sub-total—Missiles	4,115,060	−654,200	3,460,860	145,400	4,026,860	−711,400	3,315,400
Navy Vessels							
Shipbuilding & Conversion, Navy	2,848,550	−66,900	2,781,650	150,250	2,698,300	−66,900	2,631,400
Tracked Combat Vehicles							
Procurement of Equipment and Missiles, Army	298,300	+7,500	305,800	—	298,300	+7,500	305,800
Procurement, Marine Corps	37,700	—	37,700	—	37,700	—	37,700
Sub-total—Tracked Vehicles	336,000	+7,500	343,500	—	336,000	+7,500	343,500
GRAND TOTAL	15,456,010	−1,091,700	14,364,310	623,050	14,977,560	−1,236,300	13,741,200

[1] Of the amount requested for authorization, $25.0 million is to be derived by transfers from the DOD Stock Funds.
[2] Of the amount requested for authorization, $325.0 million is to be derived by transfers from the DOD Stock Funds.
[3] Reflects $15 million reduction in FY 1969 Sentinel program and NOA.

SOURCE OF FUNDS FOR THE FY 1970 RESEARCH, DEVELOPMENT, TEST & EVALUATION PROGRAM

($ THOUSANDS)

	Total Amount of Original FY 1970 Program	Funding Available for Financing Program in Part	Original Authorization Requested	Recommended Changes	Revised Authorization Request
Research, Development, Test, & Evaluation					
Army	1,822,500		1,822,500	+27,000	1,849,500
Navy	2,207,100		2,207,100	+4,400	2,211,500
Air Force	3,599,300	5,000	3,594,300	−33,100	3,561,200
Defense Agencies	500,200		500,200	—	500,200
Emergency Fund	50,000		50,000	+50,000	100,000
Total	8,179,100	5,000	8,174,100	+48,300	8,222,400

Space Probes To Study Arctic Radio Blackout

Scientists of the Air Force Cambridge Research Laboratories, the Army Ballistic Research Laboratory and the Defense Atomic Support Agency (DASA) will conduct a joint study of solar disturbance effects on radio propagation this summer in the Arctic.

The program calls for the launch of 36 instrumented research rockets to be fired from the Churchill Research Range in Manitoba, Canada.

The rockets will be fired to heights of 80 to 150 kilometers (50 to 93 miles) during a polar cap absorption (PCA) event, a radio blackout phenomenon peculiar to the Arctic region.

Measurements to be gathered during the launch program include the distribution of charged particle densities, temperatures and energies; radio transmission properties; atmospheric density; and the composition of the upper atmosphere during periods of solar proton disturbance.

Scientists hope that by studying the effects of solar activity it may be possible to develop techniques for predicting the intensity and duration of PCA events. This knowledge could be important in the future development of communication, navigation and radar systems.

The Churchill Research Range, operated by the National Research Council of Canada under joint finance by Canada and the National Aeronautics and Space Administration, is one of the largest rocket launch sites in North America.

James C. Ulwick of the Air Force Cambridge Research Laboratories, an element of the Air Force Office of Aerospace Research, is the PCA Program Technical Director. Program Manager is Dr. Charles A. Blank, Defense Atomic Support Agency.

Holloman AFB Testing Four New Missiles

The Air Force Missile Development Center, Holloman AFB, N.M., has expanded its missile testing role with the addition of four missiles to its programs:

- The Navy-developed Walleye, a television-guided, air-to-surface missile.
- The Short Range Attack Missile (SRAM), a rocket-propelled, air-to-surface, supersonic missile intended to provide strategic bombers with a "stand-off" capability.
- The anti-radiation missile Standard ARM, a second-generation electromagnetic radiation-seeking missile for use against radar sites.
- The Maverick, another development of the television-guided air-to-ground missile concept, now in the planning stages.

New Concept for Behavioral Science Research

Colonel John G. Dailey, USAF

Scientific affluence and technological skills are pushing the boundaries of man's domain outward so rapidly it literally staggers the imagination. In every field of endeavor, agriculture, medicine, aerospace, and in an infinite number of other areas, the fund of knowledge is expanding at an unprecedented rate. As this new knowledge is rapidly translated into hardware and techniques, man imposes his will on an ever more permissive "mother nature." New methods of agriculture produce food in plenty where men used to starve. New medicines and techniques in surgery save lives where disease and deformity used to kill. Engineering skills have sent men beyond the moon; yet at the beginning of this century, nature was uncompromisingly hostile to attempts at other than surface travel.

We are beginning to master man's expanding environment, but we are paying a price in the demands placed upon man's intellectual and physical capabilities. It is difficult for man to keep pace with the new demands since his natural intellect and physical capacities have remained remarkably stable over this period. Chromosome research is unlocking the secrets of genetic control and progress is being made in the field of brain chemistry but, during the foreseeable future, man will be pitted against this technological world in much the same form as he presently exists.

Several complementary avenues exist for aiding man in accommodating to the demands of the increasingly complex world in which he lives. These are improved personnel selection and improved training, better utilization, and improved job structuring along with work simplification techniques. The Air Force has increased its effort in these vital areas by establishing the Air Force Human Resources Laboratory at Brooks AFB, Tex., in July 1968. Simply stated, the mission of this laboratory is to conduct research in the areas of personnel selection, management, and training designed to insure accomplishment of the Air Force mission in the most effective and efficient manner possible.

In its initial configuration, the new laboratory brings under one headquarters two long-established units. One is the Training Research Division located at Wright-Patterson AFB, Ohio. This division was formerly part of the Behavioral Sciences Laboratory. The other unit, located at Lackland AFB, Tex., is the Personnel Research Division. This division was formerly the 6570th Personnel Research Laboratory and, like the Training Research Division, was previously assigned to the Aerospace Medical Division of the Air Force Systems Command (AFSC).

In addition to the enlargement of these two organizations, three other divisions are being planned. These are a Technical Training Division to be located at the Lowry AFB Technical Training Center at Denver, Colo.; a Flying Training Division to be located at Williams AFB, Ariz.; and a Professional Education Division to be located at the Air University, Maxwell AFB, Ala.

The laboratory will span the range of Air Force human resources research in an effort to relate basic, exploratory and applied research directly to the needs of the using agencies. The aim and guiding philosophy are to provide both an anticipatory research program to promote the state of the art needed to meet future demands, and at the same time retain a responsive capacity to meet current research needs as they are identified. The laboratory will monitor basic research pertaining to human resources as well as

Colonel John G. Dailey, USAF, is Commander of the Air Force Human Resources Laboratory. He has served as Chief, Project RAND Group, in Air Force headquarters and, prior to assuming command of the laboratory, was Director, Office of Management Activities, Headquarters, Air Force Systems Command. Colonel Dailey holds a B.S. degree from the University of Maryland and an M.B.A. from George Washington University.

conduct a limited in-house activity. The exploratory development programs will bring forward promising technology to the point of application in the field setting. The applied or advanced development program will be conducted at operational sites to demonstrate feasibility, and to further refine methods and techniques of application.

Research Proximity to User Application

An advantage of this approach to research is the systematic development of ideas from concept to utilization. It emphasizes the need to locate the elements of the research organization in geographic proximity to major centers of influence. In fact, it dictates the laboratory organization (see page 22). The Human Resources Laboratory headquarters is located at Brooks AFB, Tex., near Air Training Command headquarters at Randolph AFB, the major user of laboratory products. The Training Research Division, charged with exploratory research, remained at Wright-Patterson AFB, Ohio, to take advantage of relationships and the two-way communication of future training needs with the System Program Offices of the AFSC Aeronautical Systems Division. The Personnel Research Division is located in working proximity to Headquarters, Air Training Command, and the Air Force Military Personnel Center in San Antonio, Tex.

The other divisions will also be located with this principle in mind. Williams AFB, Ariz., was selected as the site for the Flying Training Division. Williams AFB is an Air Training Command undergraduate pilot training base. It is contiguous to the Tactical Air Command's fighter complex consisting of Nellis, Luke and Davis-Monthan AFBs. It is also centrally located with regard to undergraduate navigator training at Mather AFB, Calif., and the Strategic Air Command's combat crew training at Castle AFB, Calif. The Technical Training Division is to be located at Lowry AFB, Colo. Lowry is one of the Air Training Command's technical training centers offering a wide selection of representative technical courses, and is also the site of the Air Force 3320th Retraining Group. The Professional Education Division will be placed at Maxwell AFB, Ala., on the campus of the Air University Command where close contact can be maintained with the Air University, the Air Force Institute of Technology, and the Air Force Academy.

The proximity of researcher to user fulfills several needs. The close association, the rubbing of shoulders, in a common effort of operational significance establishes a dialogue between the research scientist and operator that is frequently non-existent when research is conducted in a setting remote from on-going operations. The scientist learns the language and acquires an appreciation of operator problems, which leads to faster and more precise identification of research requirements. Daily contact maintains alignment of the research program to the real world needs and a rapid feedback of results. Another advantage of onsite research lies in the increased capacity of the user to implement favorable research findings. Since the user is "in the loop" during the feasibility demonstration, a trained cadre is in being and ready to implement findings at the conclusion of a successful project.

Adaptive flight simulator.

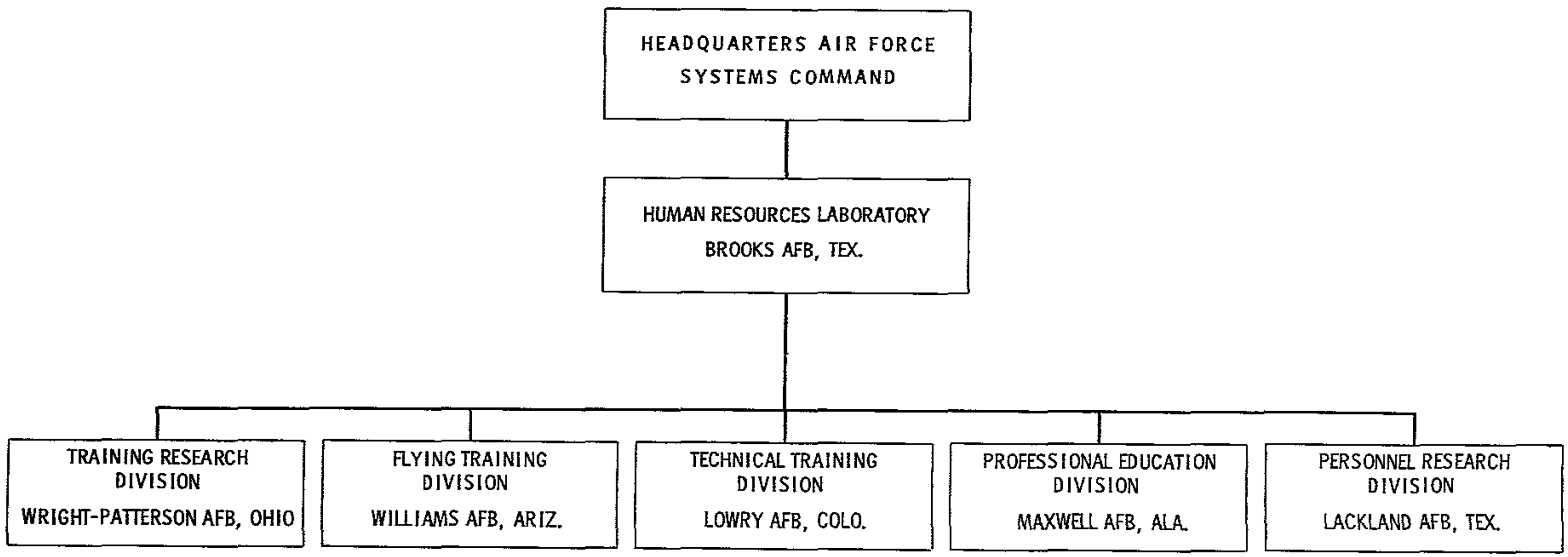
Human Resources Research Program

Although the charter of the Air Force Human Resources Laboratory implies a significant increase in capability for in-house research, the size of the task and range of problems faced will of necessity involve an enlarged contractual effort. The research program will consequently be a blend of effort which capitalizes on the strengths of both profit and nonprofit contractor organizations, and the in-house capability of the laboratory. The laboratory research program is oriented to those facets of Air Force personnel, education and training systems in which the potential for significant pay-off appears highest. The following research areas are described as representative of the program as it currently exists in either its on-going form or planned for initiation in the near future:

Flying Training Research.

This program will develop and test new concepts approaches, media, and devices for flight training. Initial emphasis will be upon undergraduate

AIR FORCE HUMAN RESOURCES LABORATORY



pilot and navigator training. However, as essential manpower and funding become available, the effort will be expanded to the combat crew training for the fighter, bomber and airlift missions. The goal is to develop improved training systems which will provide the skills demanded by present and future tactical, strategic and airlift missions in the most cost-effective manner possible.

Technical Training and Professional Education.

Here again research will be carried out to develop the technology in curricula, methods, techniques, media devices and job performance aids to simplify the training tasks and still provide the skills the Air Force must have. Individualized instruction appears to be the key. It will rely upon the most sophisticated technological advances possible, computer-aided and computer-managed to develop the high quality of technical and professional skills demanded by both the present and future aerospace systems.

Personnel and Training Requirements of Planned Force Structures.

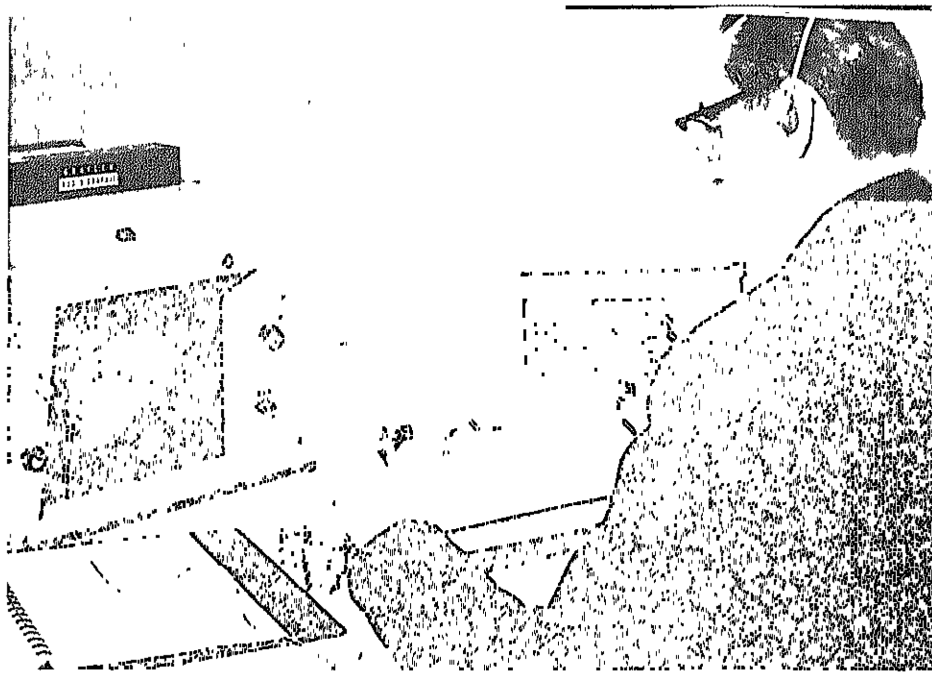
In this program, the effort is to develop and test the technology of human resources engineering, by which the training and manning requirements of planned systems can be matched with the human resources available in a timely and efficient manner.

Training and Simulation Techniques.

This program concentrates upon developing the engineering technology that is required to advance the state of the art in flight simulation. The complexity and cost of present and next generation weapon systems is so great that high fidelity full mission simulation appears to be the major improvement needed to increase proficiency to the levels demanded by these advanced systems. In addition to simulation for aerospace crew training, efforts will be devoted to simulation techniques as a tool for technical training and professional education.

Selection and Classification.

Air Force operational requirements necessitate the development of prototype tests and test batteries, and their revisions, for the continuing operation of the Air Force Personnel System. Research efforts will be oriented toward the development of predictors of success in training and on the job, new prediction systems, and new test formats and concepts. New techniques of measuring and quantifying job productivity and effectiveness will be sought.



Automated apprenticeship for technicians.

Personnel Resources and Evaluation.

This research program will concentrate upon a number of areas:

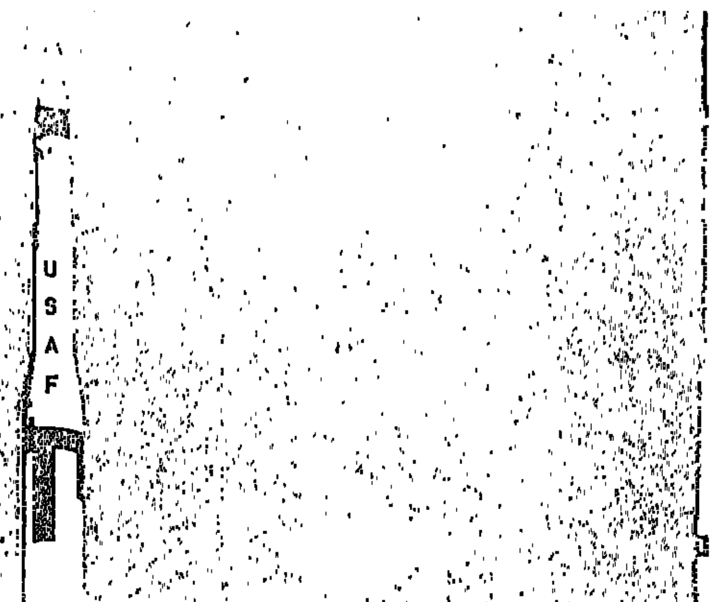
- Relationship of the characteristics of the manpower pool to Air Force needs.
- Effectiveness of recruiting and selection systems in procuring personnel possessing needed characteristics.
- Individual performance evaluation procedures and the use of such procedures in assignment and promotion.
- Measurement, prediction, and development of career attitudes and retention potential.
- Analysis and follow-up studies of the post utilization of military personnel.

Personnel Management Research.

The goal of this program is to provide for the development of command and control mechanisms for the Air Force Personnel System. Toward this goal, efforts will continue on the development of statistical-mathematical procedures to analyze and summarize personnel and cost data; the application of probability concepts for projecting and the composition of the personnel force; the development and maintenance of broad data bases on officers, airmen, and civilians; and the development of the capability to process large volumes of data to analyze large-scale problems in support of the total human resources research effort, including the development of sophisticated inquiry and display techniques.

As a final word, the Air Force investment in its human resources is a heavy one. It has a strength of over 800,000 to operate and maintain the most complex array of equipment ever devised by man. As many as 100,000 new members are recruited each year and an approximate equal number leave the service for productive civilian employment. At any point in time, a large proportion of its members are in a training status, either on the job or in formal resident courses. In such a large and ever changing organization, the problems facing personnel and training managers are formidable. The mission of the Air Force Human Resources Laboratory, to provide research leading to solutions to these problems, is challenging, dynamic and, most important, exciting. It will require an effective capacity to span the existing chasm between the mysteries of basic research, the development of this product in the nurture of the explo tory research programs, and [illegible] careful demonstration und[illegible] manding and practical rev[illegible] operational Air Forces.

Air Force Systems Command



Technology— The Goal and the Challenge

General James Ferguson, USAF

The Air Force Systems Command (AFSC) is charged with the ... the ... important management ... world involving an enormous budget of almost $8 billion. Its activities annually involve ... contracts ... take 17,000 funding actions and engage in over 275,000 contractual actions. The contracts range in value from a few dollars to over a billion dollars.

AFSC develops and procures products ranging from spacecraft, rocket boosters and missiles to military aircraft, ... associated armament, to communications systems and ... technologies with which to provide command and control of the Air Force operational capability. Its laboratories are among the largest in the Defense Department. Two test ranges provide worldwide radar and optical tracking essential to space ... Wind tunnels permit development verification for speeds to Mach ... altitudes to 250,000 feet. Rocket stands accommodate ... 600,000 pounds thrust under atmospheric conditions ... at 100,000 feet.

Our ... to maintain ... the ... management ... while ... the needs of today ... the future.

The ... has been forged. The ... of research and development has traditionally been ... the future is any point ahead of us in time. It can be ... or 10 years away. However, there is little need to prepare for the distant future unless one survives the trials of today.

The challenge is to bring that ... closer to the needs of today without diminishing our emphasis on the future.

Technology has advanced more rapidly in the past 50 years than in the previous 5,000. Yet soon after World War II, top U.S. scientists dismissed and derided the notion of an accurate intercontinental ballistic ... and as late as 1956, a noted foreign astronomer called the prospect of space travel "utter bilge."

Farsighted military planners and ... realized that we must look at least two decades ahead just to ... to survive in a ... changing world of technology. ..., the U.S. Air Force activated the Air Research and Development Command (ARDC) on Jan. ... most of the Air Force ... resources ... several commands. ARDC ... responsibility for the research and development phases of new Air Force weapons.

... the missions of ARDC and the Air Materiel Command (AMC) were ... by the Air Force, and the present Air Force Systems Command ... April ....

Organization

More than ... projects and tasks, in various stages of development and acquisition, are managed by AFSC, with more than half of them related to limited war activities. The thousands of contracts administered have a total obligation of more than $15 billion. In FY 1969 alone the $7.6 billion allocation to AFSC, most of which was earmarked to purchase weapon systems, was a larger portion

of the total Air Force budget of $27.7 billion than that of any other major command.

This workload is being managed with a manpower authorization of approximately 10,000 officers, 20,000 airmen and 32,000 civilians, all working to shorten the time between "idea" and "item." The calibre of our people more than makes up for our lack of numbers. Ninety-two percent of our research and development officers have college degrees, 65 percent hold the baccalaureate, 33 percent have masters degrees, and 2 percent have doctorate degrees.

To provide the most effective management of Air Force scientific and technical resources, AFSC, from its headquarters at Andrews AFB, Md., directs the operation of a world-wide network. From Cape Kennedy in Florida to Vandenberg AFB, Calif., and around the world, it manages some 300 separate installations or activities. Primary among these are six divisions, five development and test centers, the Space and Missile Systems Organization (SAMSO), and nine in-house laboratories.[1]

AFSC research and development activities are organized in four functional areas:

- Analyzing the technological threat.
- Advancing the technological base.
- Developing and procuring advanced aerospace systems.
- Test and evaluation of systems and subsystems.

Analyzing the Technological Threat

Due to the long lead time between the drawing board and initial operational capability (IOC) of a weapon system, it is important to U.S. national security to know in detail what other nations are doing in aerospace technology.

Foreign Technology Division (FTD), Wright-Patterson AFB, Ohio.

A future "Pearl Harbor" might give its warnings in a foreign scientific paper, a photograph, a public statement, or a May Day parade. It is the responsibility of AFSC's Foreign Technology Division (FTD) to acquire, analyze and report on foreign scientific and technological information and equipment to reduce the possibility of technological surprise. FTD's work enhances exploitation of foreign scientific and technical achievements, or weaknesses, to the advantage of U.S. aerospace research and development programs.

Highly skilled personnel using specialized equipment, including computers and a machine language translator capable of translating Russian to English at the rate of 300,000 words a day, produce finished intelligence studies on foreign aerospace technologies and electronic, aerodynamic, ballistic and space systems. Their findings, in the form of technical studies, briefs, weapon system assessments and special reports, are disseminated throughout the Defense Department.

FTD traces its ancestry back to World War I. Established as the Technical Data Section in Washington in 1917, it passed through a number of organization and title changes and has rendered a number of "sung" and "unsung" services to our country. One of the more exciting of these was participation in Project Paperclip, which brought key German scientists to this country after World War II to assist in the evaluation and exploitation of captured documents and materiel, making a considerable impact on aerospace technology.

Advancing the Technology Base

Superior, advanced aerospace systems are dependent upon strong, technically competent laboratories and a broad base of research and technology. AFSC's Aerospace Medical Division (AMD) and the nine in-house laboratories of our Director of Laboratories (DOL) provide this capability.

Aerospace Medical Division (AMD), Brooks AFB, Tex.

In any manned system, the most important component is man himself. In addition to his care and treatment, his limitations and capabilities are of vital concern in planning new systems for the Air Force.

The Aerospace Medical Division (AMD) is charged with management in the areas of bioastronautics research and development in support of the design and procurement of Air Force weapon systems. It is assigned research programs in support of the Air Force personnel system. It handles a number of clinical and aerospace medical requirements and administers post-graduate professional education programs in medicine, dentistry and aerospace medical subjects.

AMD operates research laboratories, classrooms and medical treatment facilities in Texas, Ohio and New Mexico—each of which has some unique facility or capability. At these institutions, Air Force scientists are seeking to evaluate future operational situations that will require manned

General James Ferguson, USAF, is Commander, Air Force Systems Command, with responsibility for providing the weapon systems and meeting the technological needs of the total Air Force mission. Before assuming his present command, he served as Deputy Chief of Staff for Research and Development at Headquarters, U.S. Air Force. General Ferguson is also the Director of the Manned Orbiting Laboratory Program, in addition to his duties as Commander of the Systems Command.

[1] *Editor's Note: Subsequent issues of* Defense Industry Bulletin *will carry articles about four of the major subordinate elements of the Air Force Systems Command. These are the Space and Missile Systems Organization (SAMSO), the Aerospace Medical Division (AMD), the Electronic Systems Division (ESD), and the Aeronautical Systems Division (ASD).*

Editor's Note: Organization charts appearing in the Bulletin are edited by the editorial staff to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizational elements not involved in the DOD-industry relationship have been eliminated because of space limitation.
The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.

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X3181

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Col J.C.

DCS/BIOASTRONAUTICS & MEDICINE
Brig Gen J. Bollerud
X4562

DCS/COMPTROLLER
Brig Gen H.C. Teubner
X5326

DCS/INTELLIGENCE
Col A.G. Hutchins
X4340

DCS/PROCUREMENT & PRODUCTION
Maj Gen F.J. Higgins
X2308

DCS/DEVEL PLANS
Brig Gen F.
X33

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Lt Gen
John W. O'Neill
Commander

AERONAUTICAL SYSTEMS DIVISION
Wright-Patterson AFB, Ohio
Maj Gen
Harry E. Goldsworthy
Commander

ELECTRONIC SYSTEMS DIVISION
L.G. Hanscom Field, Mass.
Maj Gen
J.J. Cody, Jr.
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FOREIGN TECHNOLOGY DIVISION
Wright-Patterson AFB, Ohio
Col
George R. Weinbrenner
Commander

AIR FORCE MISSILE DEVELOPMENT CENTER
Holloman AFB, N.M.
Col
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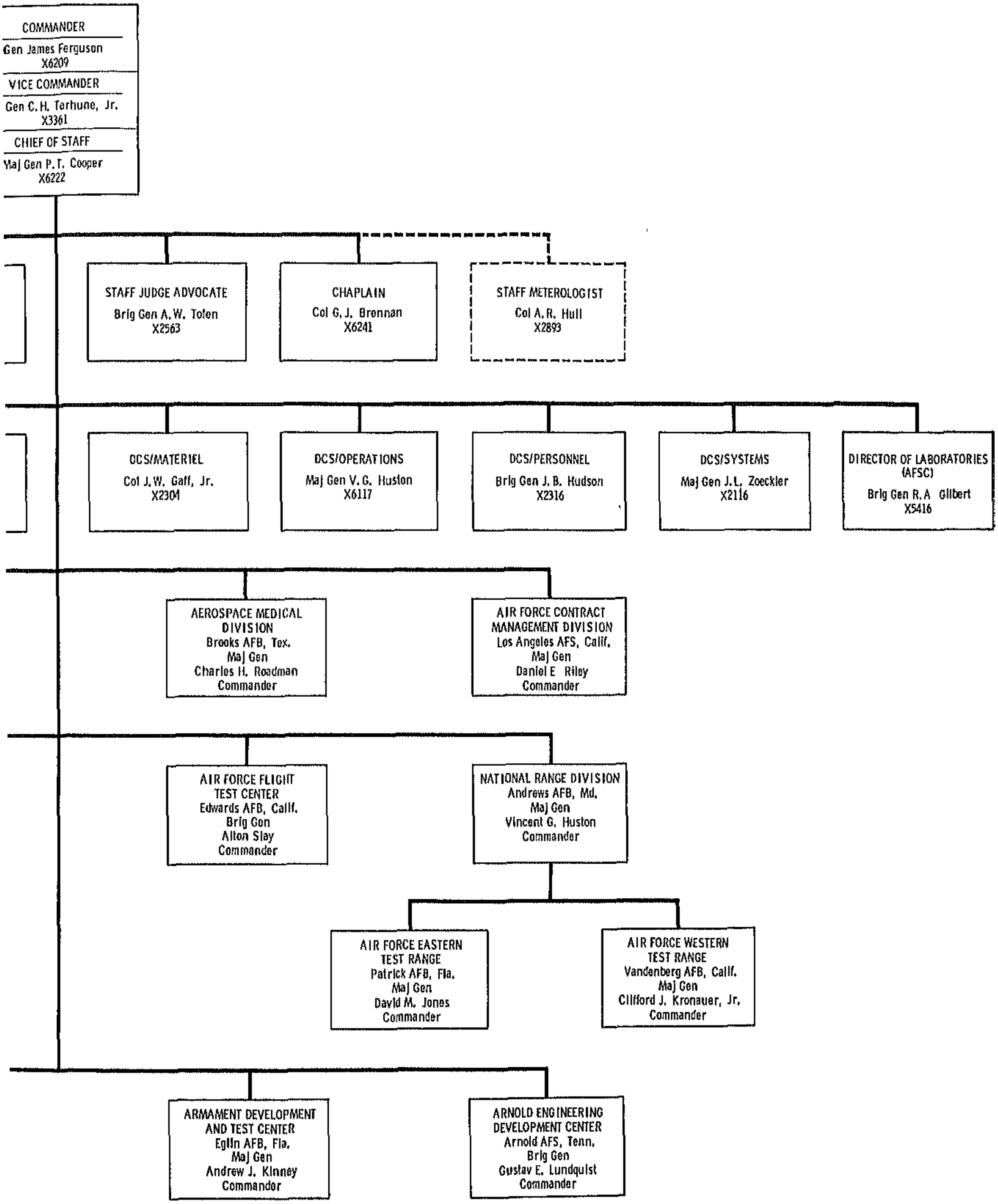
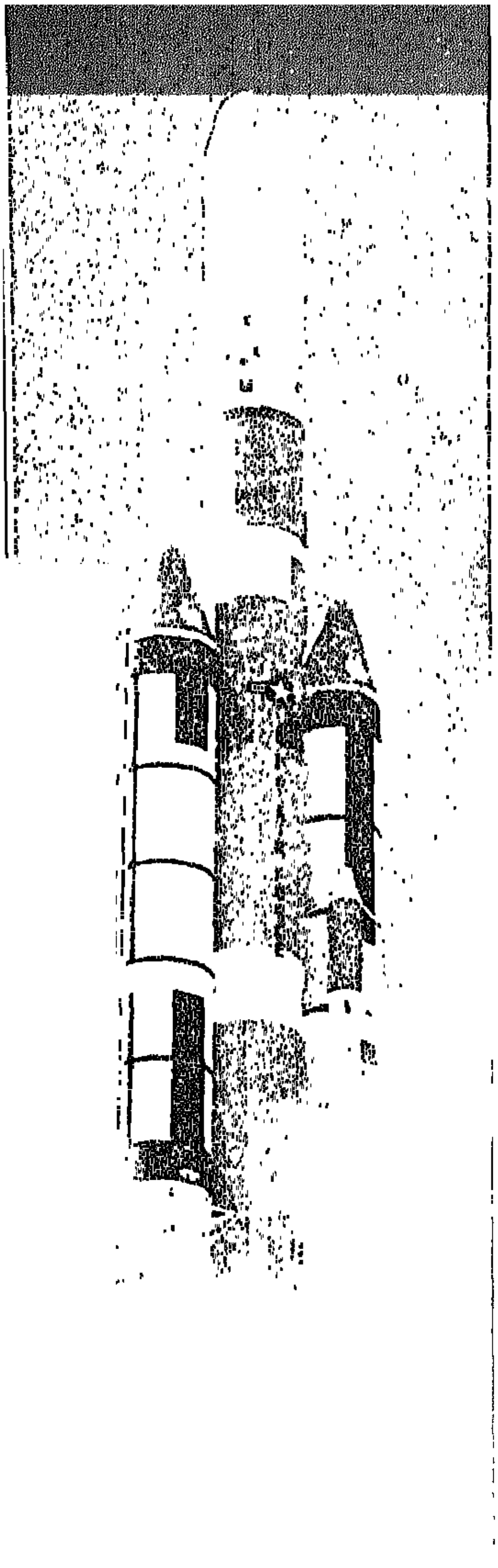




Titan IIIC, the Air Force's largest booster, pushes skyward from Cape Kennedy with the Tactical Communications Satellite (TACSAT No. 1) inside.

spacecraft, to define potential medical hazards that man might face in operating these spacecraft, and to devise methods and medicines to counteract such hazards and insure maximum crew performance.

Director of Laboratories (DOL), Andrews AFB, Md.

Prior to 1961, Air Force capability for in-house research and development was extremely limited. In June and July 1961, both the House Committee on Appropriations and the Senate Committee on Government Operations expressed concern. That July President Kennedy launched an investigation, and the following October Secretary of Defense McNamara stated that in-house laboratories must be supported and would be used as a primary means of carrying out Defense Department programs.

The Air Force approach to solving the situation was the consolidation of its research and technology activities into a streamlined organization to rebuild in-house technical competence. In July 1962, the Research and Technology Division (RTD) was created within the Air Force Systems Command, and later evolved into the Director of Laboratories (DOL) in AFSC headquarters.

The DOL is responsible for the creation of a broad base of research and technology, which can be applied to the maintenance of effective operational forces in being. It is concerned with the timely modernization of these forces, and the exploitation of technology to meet future Air Force requirements for advanced aerospace systems.

The DOL is responsible for more than 1,700 research and engineering contracts valued at $440 million. Yearly operating funds of $328 million have been required to operate the laboratories, and an additional $140 million has been expended yearly on behalf of other government agencies engaged in research and development work. The technical facilities of the nine laboratories are valued at more than $400 million.

Each laboratory is charged with planning and executing AFSC exploratory and development programs, and serves as the Systems Command focal point for all available information in its assigned areas of technology.

The laboratories, their locations and missions are:

- **Rome Air Development Center (RADC), Griffiss AFB, N.Y.** The Rome Air Development Center (RADC) is the largest of the laboratories in manpower strength, with more than 1,500 scientists, engineers and supporting personnel.

Its involvement in the electromagnetic areas of transmission and reception is essentially in ground communications. Satelliting the RADC complex are 15 remote facilities within an approximate radius of 200 miles from Griffiss AFB.

RADC accomplishes research, development and test of electronic systems for detection, control, identification and countermeasures; navigation, communications and data transmission systems; and associated components and related automatic flight equipment.

- **Air Force Weapons Laboratory (AFWL), Kirtland AFB, N.M.** The Air Force Weapons Laboratory (AFWL) works closely with the Air Force Special Weapons Center (AFSWC) at Kirtland AFB, N.M., and the Atomic Energy Commission in planning, managing and conducting exploratory and advanced development programs associated with nuclear and other non-conventional advanced weapons, and their applications.

The nearly 500 scientists and engineers there study the effects, delivery techniques and hazards of these weapons, and the utilization of nuclear power. Facilities are composed of the main laboratory complex at Kirtland AFB and two facilities at adjacent Sandia Base.

- **Air Force Rocket Propulsion Laboratory (AFRPL), Edwards AFB, Calif.** "Forging tomorrow's rocket propulsion systems today," the Air Force Rocket Propulsion Laboratory (AFRPL), the largest tenant facility at Edwards AFB, is a $150-million aggregation of high-thrust rocket engine test stands and complex research equipment.

Highly specialized Air Force and contractor development engineers at this laboratory perform research on rocket propulsion systems in five major areas: liquid rocket technology, solid rocket technology, development of liquid and solid rocket propellants, advanced propulsion techniques, and

development of rocket propulsion instrumentation and techniques.

AFRPL scientists and engineers had leading roles in development of propulsion systems for the Thor, Atlas, Minuteman, Titan and Blue Scout programs, and rockets for the X-15 research aircraft.

• **Air Force Armament Laboratory (AFATL), Eglin AFB, Fla.** The crisis in Southeast Asia pointed up the need for high priority development of non-nuclear munitions. The Air Force Armament Laboratory (AFATL) provides the Air Force with a technical capability tailored to meet many of the urgent demands generated by the current conflict.

The titles of AFATL's five divisions reveal the scope of its endeavors: engineering, ballistics, weapons, biological-chemical, and targets and missiles. Most often on center stage these days is the Weapons Division, which is responsible for concept formulation and design of conventional armament hardware. From this division come most of the weapons that are being used in Vietnam and the weapons that will be used tomorrow.

A vigorous program is being carried on to seek out and exploit new phenomena and techniques that may provide significant advances in the state of the art in such areas as shock hydrodynamics, detonation physics, the chemistry of explosives, warheads, and explosive fuel munitions.

• **Air Force Human Resources Laboratory (AFHRL), Brooks AFB, Tex.** The Air Force Human Resources Laboratory (AFHRL), the newest Systems Command subdivision, went into operation July 1, 1968, designed to be the focal point for Air Force research and development effort to satisfy technology needs in human resources education, training and management.

The laboratory is charged with planning and executing research, and exploratory and advanced development programs in personnel selection, management and career development; personnel motivation and retention; personnel force structures and composition; training techniques and equipment; personnel requirements for advanced weapon systems; and career education.

• **Air Force Aero Propulsion Laboratory (AFAPL), Wright-Patterson AFB, Ohio.** The Air Force Aero Propulsion Laboratory (AFAPL) is a large complex concerned with air-breathing, electric and advanced propulsion systems. It also deals with fuels and lubricants, power generation and aerospace support, providing technological input to Air Force decision makers and offering quick-reaction solutions to specific problems.

The laboratory is doing exploratory and advanced development work on devices, such as turbojets, ramjets and scramjet engines, and is working on capabilities for operations in space.

AFAPL plans for far into the future. Its scientists speak of speeds of more than Mach 10 in terms of "when" not "if." It has people actively engaged on proposals forecasting propulsion systems 20 years hence.

A multi-function, minimum-reaction space tool is tested in a weightless experiment at the Aero Propulsion Laboratory.

• **Air Force Materials Laboratory (AFML), Wright-Patterson AFB, Ohio.** The Air Force Materials Laboratory (AFML) is the Air Force's oldest laboratory, celebrating its 51st birthday last December. It strives "to evolve new materials and materials production technology, and encourage rapid utilization of new materials in Air Force applications."

In servicing hardware—space and reentry vehicles, aircraft and missiles—the laboratory tests its materials against the properties of stress, vibration, impact, fatigue, time, high and low temperatures, corrosion, oxidation and weight savings.

Some of its specific objectives are to develop and test improved metals, plastics, adhesives, graphites, ceramics and composites for structures and propulsion; elastomers for seals and sealants; electrical, electronic and magnetic materials, materials for deceleration devices and expandable structures; and protective techniques.

• **Air Force Avionics Laboratory (AFAL), Wright-Patterson AFB, Ohio.** "Avionics" is a word coined during World War II, when it was discovered that an aircraft without "round-the-clock" capability was only a partially effective weapon. Radar was applied to the bomb-directing and fire control functions, and electronic circuits were developed to assist in navigation, aerodynamic and engine control, and surveillance—in fact, to most of the aircraft systems.

Today avionics is formally described as "the development of elec-

trical and electronic devices for use in aviation, especially of electronic control systems for aircraft and airborne weapons."

Among advanced programs assigned the Air Force Avionics Laboratory are avionics communications, bionics, lasers, molecular electronics, electromagnetic vehicle environment, camouflage, antennas, electromagnetic warfare, navigation, guidance, weapon delivery, and aerospaceborne surveillance.

• **Air Force Flight Dynamics Laboratory (AFFDL), Wright-Patterson AFB, Ohio.** At the Air Force Flight Dynamics Laboratory (AFFDL) we strive for advancement of technology needed in the design of future flight vehicles for all foreseeable needs. Work performed at this laboratory is principally in the areas of flight control, flight mechanics, vehicle dynamics, vehicle equipment, V/STOL and structures. AFFDL is participating in the evolution of the AX, F-15 and V/STOL system programs, both in-house and through prospective contractors. It works with all Military Services to establish structural dynamics criteria.

Four of the laboratory's prime facilities are considered national in scope, having "sole or unique technical characteristics." One of these is the Sonic Fatigue Facility. The Federal Aviation Agency sponsors many tests conducted here, including human tolerance limits to high sound levels.

Developing and Procuring Advanced Aerospace Systems

At our three systems divisions, AFSC is applying advanced technology to the development, acquisition, installation and test of Air Force electronic command, control and communications systems; development and acquisition of aeronautical systems and related equipment; and to managing all Air Force ballistic and space systems, present and future.

Electronic Systems Division (ESD), L.G. Hanscom Field, Mass.

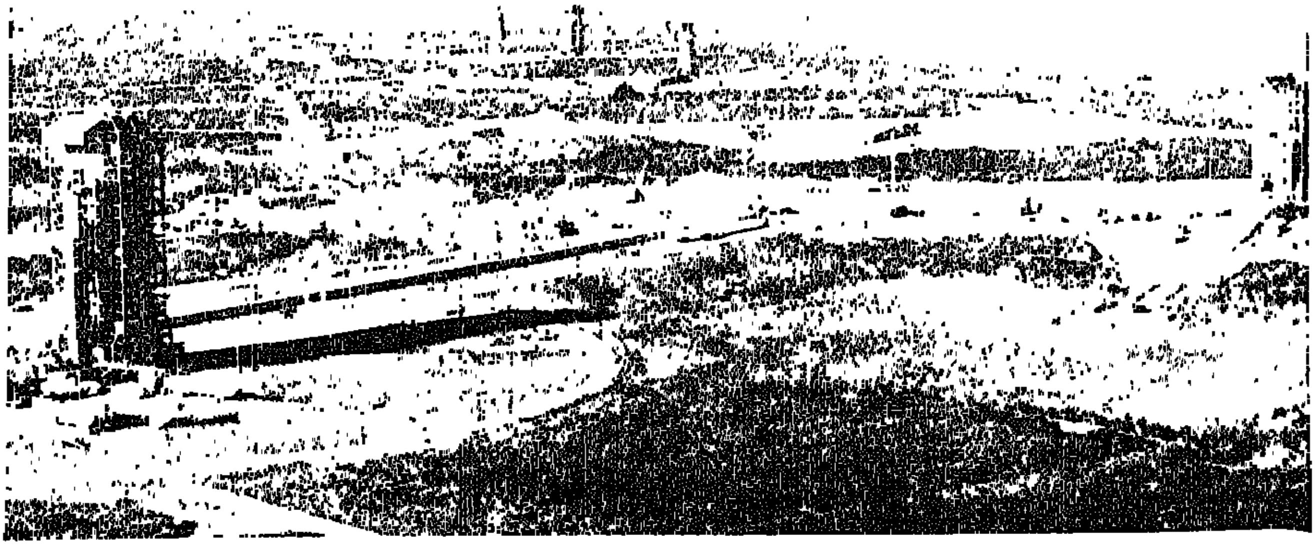
In this aerospace age of 18,000-m.p.h. missiles and weapons of tremendous destructive power, the age-old problem of communicating information has taken on new significance. The nature of an attack, either from missiles of an infinite variety or high performance aircraft, must be quickly ascertained, communicated, and displayed to commanders.

The Electronic Systems Division (ESD) designs, procures, tests, installs and checks electronic systems for use by such organizations as the Strategic Air Command, Tactical Air Command, Air Force Communications Service, Air Weather Service and the North American Air Defense Command. Specialized command centers enable military commanders to assess the total defense situation and the status of Air Force retaliatory forces.

From Europe to the Pacific and throughout the North American continent, ESD systems collect information about aircraft movements, missile launchings and man-made objects in space. The data collected are transmitted via tropospheric, microwave, cable, radio, or other means to the command centers where computers process the millions of bits of information. Information immediately vital to the decision makers is displayed to aid in the decision-making process.

Aeronautical Systems Division (ASD), Wright-Patterson AFB, Ohio.

Cape Kennedy Air Force Station's "ICBM Row." The cape is Station No. 1 on the Air Force Eastern Test Range.



The Aeronautical Systems Division (ASD) is the largest of our subordinate units. It annually spends about $5 billion—more than all the other elements of the Systems Command combined. Most ASD dollars are earmarked for developing and acquiring airplanes that vary in size from small trainers to the largest transports. The division manages aircraft programs contracted to industry from their conception through the various stages of development, testing and production.

ASD's role in aircraft development dates back to the beginning of manned flight itself. The first U.S. Government aircraft ever purchased was bought on contract from Orville and Wilbur Wright of nearby Dayton. The Wrights' $25,000 contract for "one heavier-than-air flying machine" set the pattern for government-industry cooperation that has continued for more than 40 years. Today ASD's contracts represent a total obligation of more than $10 billion.

The division currently manages some 50 aircraft and non-ballistic missile systems in support of the full range of Air Force operational missions and future requirements.

Space and Missile Systems Organization (SAMSO), Los Angeles AFS, Calif.

In 1954 a handful of Air Force officers met in a schoolhouse in Inglewood, Calif., just a few miles from the present complex at Los Angeles Air Force Station, where the Space and Missile Systems Organization (SAMSO) is located. Their mission was to provide this nation with an intercontinental ballistic missile (ICBM) capability in the shortest possible time.

From this nucleus grew the Space and Missile Systems Organization, the management agency for most Air Force ballistic and space systems, present and future. Almost three-fourths of the space flights undertaken by the Free World have been launched by SAMSO-developed boosters and SAMSO aerospace test wing crews.

Major current programs include the development and deployment of advanced Minuteman weapon systems; conceptual studies of an advanced ICBM; research and development work in Advanced Ballistic Reentry Systems (ABRES); space boosters for heavy and multiple payloads; certain phases of the Manned Orbiting Laboratory (MOL); assisting in the Defense Satellite Communications System; studies in space escape and rescue; and launch of a wide variety of space and planetary probes.

National Range Division (NRD), Andrews AFB, Md.

From its headquarters, the National Range Division (NRD) develops, controls, operates and maintains the Air Force Eastern (AFETR) and Western Test Ranges (AFWTR), in support of national ICBM and space programs. The primary responsibility of the headquarters is central planning of range development, insuring compatibility of equipment, and the control and balancing of resources. The responsibility of operations and maintenance in support of specific space and missile programs rests with the AFETR and AFWTR commanders.

• Air Force Eastern Test Range (AFETR), Cape Kennedy AFS, Fla. AFETR extends 10,000 miles downrange from Cape Kennedy to the Indian Ocean, with island stations at Grand Bahama, San Salvador, Grand Turk, Antigua and Ascension. Last station in the chain is at Pretoria, Republic of South Africa. Radar, optical and continuous wave devices track test vehicles, while telemetry equipment records vital information of the flight performance. Especially instrumented Air Force aircraft and ships are used to fill in the gaps between the island tracking stations.

A military-civilian work force of about 15,000 provides support services to all range users in their missile and space exploration projects.

• Air Force Western Test Range (AFWTR), Vandenberg AFB, Calif. Complementing AFETR to provide a national range with global capability, tracking and data gathering sites of the Air Force Western Test Range (AFWTR) are located at Vandenberg AFB and Pillar Point in the United States, and Wheeler AFB, Hawaii; and Eniwetok Island in the Pacific Ocean. In addition, data gathering facilities, at Point Mugu, Calif.; Kaena Point and Kokee Park, Hawaii; and Kwajalein, Wake and Midway Islands, are operated by other government agencies.

AFWTR specializes in polar orbit launches and supports the operational training launches of the Strategic Air Command (SAC). Eniwetok Atoll, situated in the northern Marshall Islands 2,380 miles southwest of Honolulu, serves as the main impact area for SAC's ICBMs launched from Vandenberg. Eniwetok's two main tasks are to score the accuracy of reentry vehicles and to recover the vehicles from the ocean.

Performance measurement falls into two categories: metric trajectory measured by ground sensors, and telemetry transmitted from the launch vehicle.

Air Force Contract Management Division (AFCMD), Los Angeles AFS, Calif.

To satisfy today's expanding range of system requirements in the face of increasingly stringent budget restrictions, we must insure a full dollar's value for every dollar spent. We strive for balance in allocating available resources between systems development and a sound technological base; and we must achieve effective, efficient management in both endeavors.

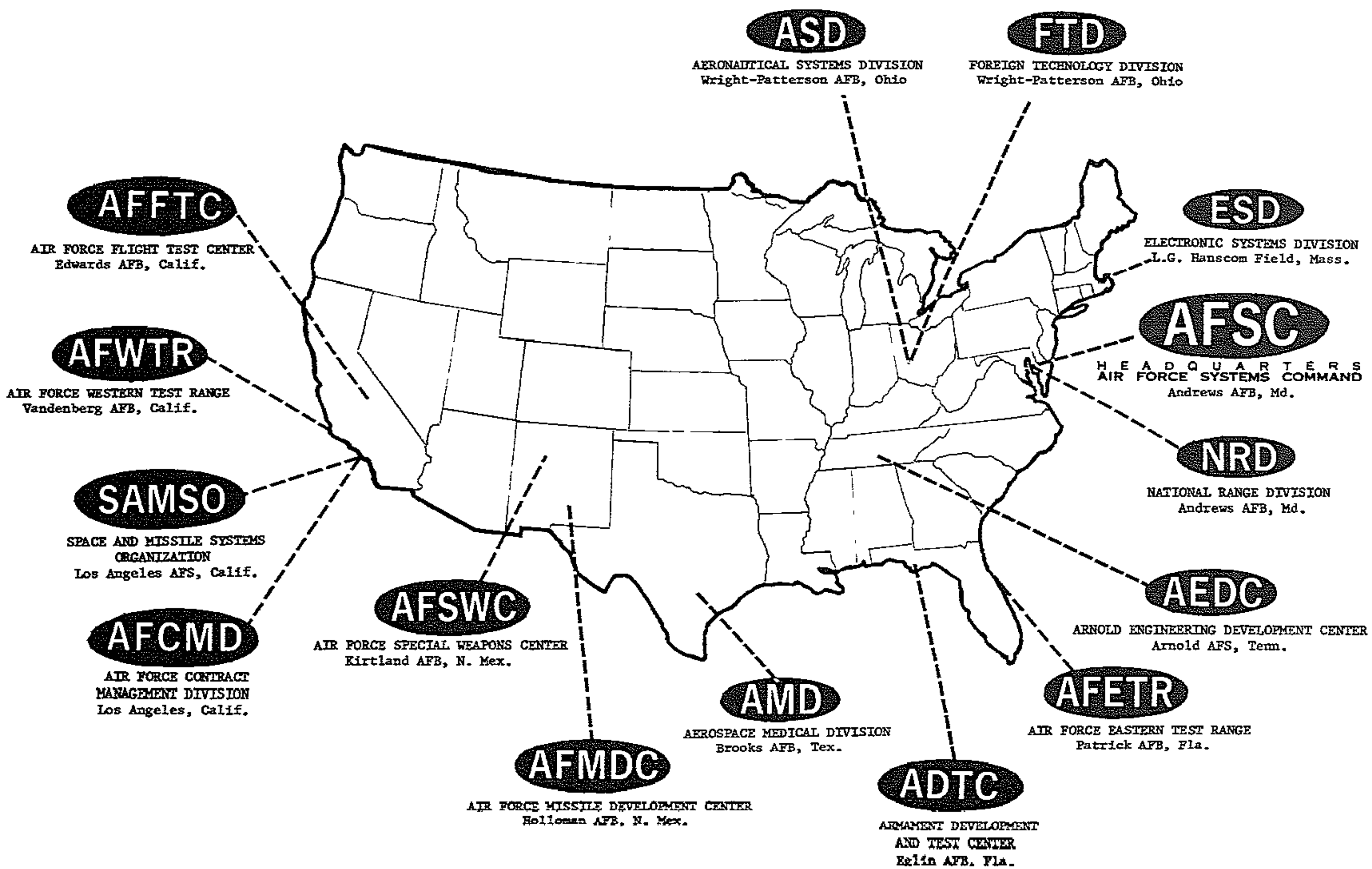
To meet this requirement and to supervise and manage performance on government contracts at facilities assigned to the Air Force for plant cognizance, the Air Force Contract Management Division administers thousands of contracts for DOD and other government agencies.

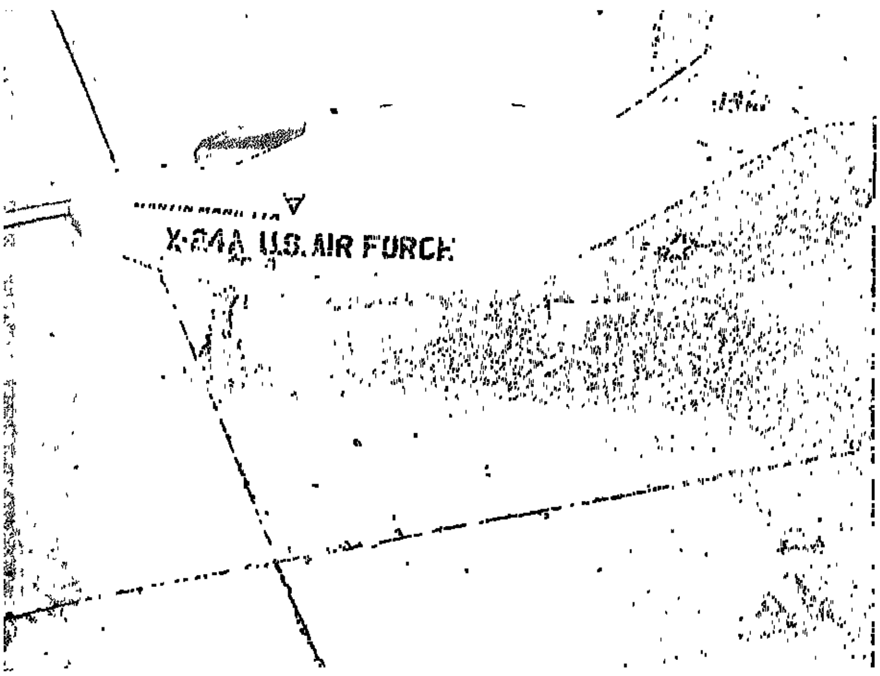
Twenty-three Air Force Plant Representative Offices (AFPROs), located at contractors' facilities, provide on-the-spot representation and progress reports on the status of work at each plant. Close attention is paid to reliability, cost control, and adherence to schedules to assure that the items under contract are produced economically and in accordance with contractual requirements.

Test and Evaluation of Systems and Subsystems

Our research and test centers conduct tests and evaluations of manned aircraft and aerospace vehicles; air-to-air missiles and drones; high speed captive sled track missiles; nuclear effects simulation; aeronautical weapons and non-nuclear munitions; and atmospheric, ballistic, orbital and space flight simulations.

AIR FORCE SYSTEMS COMMAND





The X-24 rocket-powered manned lifting body is being tested at AFFTC in program to explore flight characteristics of lifting bodies, wingless flight vehicles which derive lift from their shape alone.

Air Force Special Weapons Center (AFSWC), Kirtland AFB, N.M.

At Air Force Special Weapons Center (AFSWC), the task is to make certain that Air Force missiles, aircraft, and command and control systems can survive the effects of nuclear explosions; and that no enemy action, offensive or defensive, can prevent Air Force strategic weapons from reaching their targets.

The center analyzes every component of an operational weapon system in all conceivable nuclear explosion environments from launch to target. It simulates explosion phenomena by non-nuclear methods which artificially create effects like shock and blast waves, the electromagnetic pulse, and transient radiation.

To carry out its nuclear development responsibilities, the center flight tests new equipment, including ballistic cases, bomb suspension and release equipment, arming and fusing devices, and an air-launched, air-recoverable, nuclear explosion detection rocket. It operates a large, well-equipped environmental test laboratory with sand, dust, humidity, temperature and vacuum chambers. Its fabrication facilities include one of the nation's finest experimental machine shops and microelectronics/instrumentation laboratories.

Air Force Missile Development Center (AFMDC), Holloman AFB, N.M.

Located on the edge of the White Sands Missile Range, the Air Force Missile Development Center (AFMDC) has an unusually diversified set of tasks. Among other responsibilities, it conducts and supports the test and evaluation of airborne missiles, target drones, aircraft fire control systems, missile reentry vehicles and aids, and guidance systems.

It operates the Central Inertial Guidance Test Facility, which has advanced equipment for testing gyroscopes, accelerometers and entire guidance systems. It also operates the Radar Target Scatter Site (RATSCAT) facility to collect characteristic radar "signatures" which are reflected from weapon systems, nose cones, decoys and aerospacecraft.

Probably one of the best known test items under AFMDC's direction is the nation's longest, high-speed test track, a seven-mile long "space age railroad" used in testing missile configuration, the effects of rain erosion, aircraft seat ejection systems, and guidance systems. It is the most precisely aligned and completely instrumented, high-speed test track in the Free World.

Armament Development and Test Center (ADTC), Eglin AFB, Fla.

The need for non-nuclear, conventional warfare capabilities, pointed up by the war in Southeast Asia, brought with it an upsurge of activity at Armament Development and Test Center (ADTC), located at Eglin AFB, Fla., the Air Force's largest base.

ADTC develops, tests and acquires conventional munitions for counterinsurgency and limited warfare. Aircraft systems, subsystems, allied equipment, guns, bombs, rockets, targets and drones, new high-power frequency diversity early warning radars, airborne electronic countermeasures equipment—all are tested and evaluated on eight test ranges, eight auxiliary airfields, and the large Eglin Gulf Test Range.

Its Climatic Laboratory, the world's largest environmental testing facility is a huge, "deep-freeze oven" where aircraft, missiles and support items of equipment can be functionally tested and exposed to any simulated arctic or tropic environment. The laboratory can be controlled to a frigid 5 degrees Fahrenheit below zero or to a baking 165 degrees above zero.

Air Force Flight Test Center (AFFTC), Edwards AFB, Calif.

Nearly every kind of aircraft used by the Air Force since 1946 has been tested at the Air Force Flight Test Center (AFFTC), Edwards AFB. Here experimental and acceptance flight testing for aircraft and aerospacecraft entering the inventories of the Air Force, its sister Services and other governmental agencies is conducted to determine whether they meet established requirements and design objectives.

The supersonic age of flight began at the center's relatively isolated 300,000 acres with the X-1 rocket plane in 1947, and has progressed through the now famous X-15 manned research rocket plane and the X-24 rocket-powered lifting body, forerunners of the aerospacecraft of the future. More conventional aircraft under test at Edwards include the A-7, F-111, SR-71 and YF-12. Aided by natural as well as constructed facilities, AFFTC's 15,000-foot man-made runway is supplemented by dry lake beds with natural

runways up to 13 miles long. Extremely good weather allows flight testing up to 350 days per year.

AFFTC is also the home of the Aerospace Research Pilot School (ARPS), the only training facility of its kind in the Free World, where pilots for tomorrow's aerospacecraft are taught to master the environment of space.

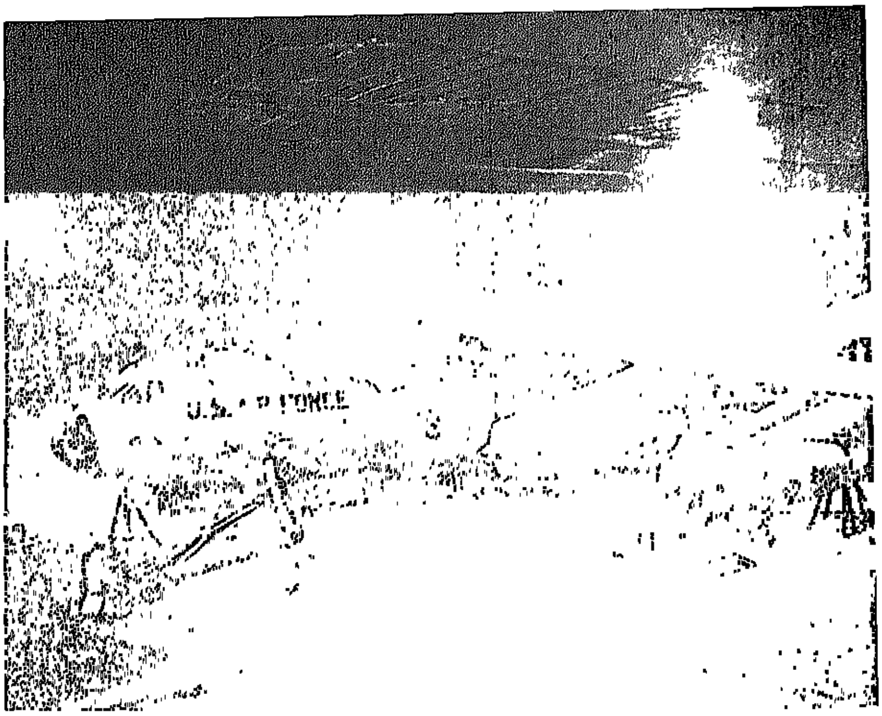
Arnold Engineering Development Center (AEDC), Arnold AFS, Tenn.

The Arnold Engineering Development Center (AEDC) is a $400-million "national resource" situated on a 40,000-acre reservation near Tullahoma, Tenn. It maintains and operates high-performance wind tunnels, high-altitude propulsion system test cells, and space environmental chambers in which large or full-scale models of aircraft, missiles, satellites, and space vehicles, and their propulsion systems can be tested under conditions simulating a broad range of flight environments.

The center supports practically every high-priority aerospace program of the nation, including those for the National Aeronautics and Space Administration, the Army and Navy. With the capability to simulate flight conditions from sea level to space, the center's technical facilities present major state-of-the-art changes in themselves. Yet, these facilities must be in existence prior to the systems they will test, and whose progress they can pace or appreciably accelerate.

Major facilities include:

- von Karman Gas Dynamics Facility for testing aerodynamic scale models under extreme flight conditions.
- Rocket Test Facility for testing full-scale propulsion systems for aircraft, missiles and space vehicles under simulated operating conditions.
- Large Rocket Facility for testing the larger liquid and solid propellant rocket engines.
- Propulsion Wind Tunnel for testing full-scale aircraft and large-scale missile models, together with their operating propulsion systems, under realistic flight conditions.
- Aerospace Environmental Facility for simulating space environments up to 300 miles above the earth's surface.



A C-141 Starlifter undergoes freeze tests in the Climatic Laboratory at the Armament Development and Test Center, Eglin AFB, Fla.

A Glance Ahead

Air Force Systems Command is charged with the responsibility of being in two places at once—on the frontier of future opportunity and on the doorstep of present problems. Looking for new technologies to overcome present problems and ways to meet the difficulties of the future provide the basis for the command's research and development charter. Put simply, if we expect our 1980 weapon systems to be preeminent in overall effectiveness, we must be sure that contributing laboratory projects are on the bench in 1970.

In looking to the future, we have already selected certain items to be carried through their development to at least an initial operational capability. These include the Airborne Warning and Control System (AWACS), the Advanced Manned Strategic Aircraft (AMSA), the F-15 air superiority fighter, the AX attack aircraft and the Light Intratheater Transport (LIT).

Advanced development programs, designed to demonstrate feasibility of critical components or techniques necessary to the full development of some other systems, will also receive high priority. Examples include the development of overland radar directly keyed to the success of AWACS, and studies of turbine engines for the F-15 aircraft.

In the development of the new F-15 tactical fighter, the importance of research and exploratory developments on long lead-time hardware and test facilities is dramatically illustrated. If we had not in past years laid down facilities capable of testing this airplane, it would now be too late.

With the work being done now in our laboratories, we hope to forge new breakthroughs in such critical areas as laser technology and composite materials. In procurement, the philosophy of contract definition in hardware—what could be called a competitive "initial development"—can allow us to base our source selection on a hundred cubic feet of hardware rather than a hundred cubic feet of paperwork. The benefits of this approach will result in decisions made upon hard technical data, simulated competition, and a lowered risk rate in meeting calendar commitments for initial operational capability.

AFSC's goals and challenge are one and the same—TECHNOLOGY—for delivering the goods needed today and preparation for those required in the future. With the support of American industry, I am confident the command can and will meet this important test.

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Organizations registered for service may obtain microfiche copies of these documents without charge from:
Defense Documentation Center
Cameron Station
Alexandria, Va. 22314
All organizations may purchase microfiche copies (65¢) or full-size copies ($3) of the documents (unless otherwise indicated) from:
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Procedures for Fracture Toughness

(Continued on page 40)

A Dependable Supplier Who Often Gets Personal with Customers

Brigadier General Glen J. McClernon, USA

A U.S. patrol maneuvers cautiously through the bramble of a Vietnam jungle toward a tiny village identified as a suspected Viet Cong outpost. The eyes of the men search the underbrush for mines and punjii sticks, their ears listen attentively for any foreign sound—a crackling branch, a rustling bush.

Suddenly the area around bursts with enemy weapons fire and the patrol leader signals his radioman to call for support. At a time such as this dependable electronic equipment is of the utmost importance. A time like this emphasizes the importance of government-industry teamwork in providing the Armed Forces with the best in military equipment.

At the Defense Electronics Supply Center (DESC), Dayton, Ohio, where electronic components are managed for defense, space and other programs, the importance of quality is constantly in the foreground of management attention. Established in 1962 under the Defense Supply Agency, DESC currently manages over 600,000 items and has an inventory valued at roughly a half-billion dollars. Its products include such hardware as resistors, capacitors, filters, networks, fuses, circuit breakers, switches, connectors, relays, coils, transformers, crystals, electron tubes, semiconductor devices, audio materiel, antennas, waveguides, synchros and resolvers, plus miscellaneous electronic components.

Most of the items are earmarked for military use by the Army, Navy, Air Force and Marine Corps. However, the center also provides support to an increasing number of Federal civilian agencies, such as the National Aeronautics and Space Administration, Coast Guard, Federal Aviation Administration, Post Office and Maritime Administration.

Because of the vital missions of its customers and the critical applications of its items, DESC's total support—service as well as the supplies themselves—is geared not only toward reliability but response as well. In fact these two ingredients are built into the framework of its operations in order to get quality hardware into the hands of the customer within the shortest time possible.

DESC's reaction capability was tested when a warehorse at DaNang Air Base, Vietnam, was destroyed during the 1968 Tet offensive. Within 24 hours after the attack, some 6,780 requisitions for replacement parts were forwarded to DESC and its sister DSA activity, the Defense General Supply Center in Richmond, Va., where some electronic supply classes are also managed. DaNang officials reported that 94 percent of the requested items arrived within two weeks and the remainder shortly thereafter.

Instant Response to Customer Demands

Certainly such swift service would not have been possible were it not for industry cooperation and DESC's streamlined supply system—a system which permits DESC to react almost instantly to customers demands.

Those DaNang requisitions, for instance, were relayed to DESC over the world's fastest communications system, the Automatic Digital Network (AUTODIN). A high-volume, computer-controlled communications operation, AUTODIN transmits and receives teletype, punch card, an magnetic traffic to and from point throughout the world. It is manage by the Defense Communication Agency and staffed by the Air Forc Communications Service. The switcl ing terminal located at DESC aut matically processes between 30,000–125,000 messages daily with almos 100-percent accuracy, and handles ap proximately 98 percent of the center' supply orders.

Companion to AUTODIN at DES is another communications syste managed by the Defense Suppl

Brigadier General Glen J. McClernon, USAF, is the Commander, Defense Electronics Supply Center, Dayton, Ohio. Prior to his present command, he was Director of Maintenance Engineering for the Air Force Logistics Command. In previous assignments, General McClernon was Deputy for Production and Director of Maintenance, Sacramento Air Materiel Area; and Director of Maintenance, for Air Materiel Area, Pacific Far East Air Force.

DEFENSE ELECTRONICS SUPPLY CENTE

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Phone: (513) 252-6551

Editor's Note: Organization charts appearing in the Bulletin are edited by the editorial staff to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizational elements not involved in the DOD-industry relationship have been eliminated because of space limitation.

The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.

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DEPUTY COMMANDER
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Defense Electronics Supply Center

	FY 1968		FY 1967
Procurement (62.2 percent competitive in FY 1968)	$ 198.3	(mil)	$ 280.7
Small Business Contract Awards	$ 43.2	(mil)	$ 74.6
Labor Surplus Area Contract Awards ($10,000 and above)	$ 4.9	(mil)	$ 7.1
Inventory (as of June 30)	$ 520.2	(mil)	$ 486.2
Personnel			
Military (as of June 30)	43		43
Civilian (as of June 30)	3,607		3,839
Requisitions Processed (Gross)	6,488.0	(thous)	6,590.9
DSA Managed Items	647.6	(thous)	605.5
Depot Line Items Received (DSA Material)	330.4	(thous)	411.8
	4.4	(thous) short tons	6.6
Depot Line Items Received (DSA Material)	2,696.3	(thous)	2,927.0
	5.6	(thous) short tons	5.5

Agency, *i.e.*, the Defense Automatic Addressing System (DAAS). This system, which also has a West Coast satellite at McClellan AFB, Calif., is used to group and route supply traffic to its proper destination.

If you can imagine a housewife addressing her Christmas cards, you can appreciate what DAAS means to defense logistics. Most likely, the housewife will research every address and question whether or not some have changed. Then she'll batch all the cards and ready them for mailing. It all takes time.

With automatic addressing, the process—research, verification, batching—is totally automatic. Computers, with up-to-date information on all items and their supply addresses, properly route transactions to their respective destinations, thus preventing misaddressed communications, bottlenecks and other delays.

All DESC requisitions transmitted by the AUTODIN/DAAS network flow directly into the center's data processing complex—an operation commonly regarded as the backbone of the DESC system.

At DESC computers currently receive and fill requisitions, notify warehousemen where to locate stock, map out necessary shipping instructions, and handle financial arrangements related to the transactions. Computers also regulate stock levels throughout the DESC distribution system and provide supply intelligence to key operating elements such as purchasing and item management.

The computers have proven to be handy gadgets for administration, too. They are used to process the civilian payroll plus the personnel management and promotion systems.

Since 1965, DESC computers have also been involved in a special Defense Department placement effort. In conjunction with the Centralized Referral Activity at DESC, the machines find jobs for displaced DOD workers, locate vacancies for civilians returning from overseas assignments, assist activities abroad in recruiting talent located in the United States, and aid Vietnam-era veterans in obtaining Federal jobs. In addition, a fifth system will be introduced this fall to find jobs in Government and industry for retired military enlisted men and officers.

Distribution System

Once the computer completes processing a requisition, DESC's distribution system moves into action. For those requisitions which can be filled from stock (more than 90 percent of the orders are filled from stock waiting in bins), the center employs a nation-wide distribution system to speed materiel to its customers. The bulk of supplies are shipped from principal points at Dayton, Ohio, and Ogden, Utah. Navy Supply Centers at Norfolk, Va., and Oakland, Calif., supply the Fleet and overseas Naval activities, and DOD installations within their immediate areas.

The streamlined depot system at Dayton explains how DESC can fill demands so quickly. Inside warehouses at the center, stockpicking devices, computers, and central location of all high-volume items, collectively, reduce footwork and increase the tempo of supply service. As stock moves through the processing cycle, it proceeds through a mechanized network of more than three miles of conveyor lines and an automated packing operation capable of sorting and consolidating approximately 15,000 items daily.

Intensified, Personalized Management

Though the communications devices, computers and conveyors seemingly do it all, they do have certain shortcomings. With a half-billion dollars invested in inventory and orders arriving at the rate of one every five seconds, supply management at DESC is truly big business. It is obviously too big for a team of supply specialists to properly handle alone, and too sensitive to entrust totally to a machine.

To buttress its supply effectiveness, DESC has negotiated a compromise by parlaying its physical equipment into what might be described as an "intensified and personalized management system." In a sense, it is sort of a checks-and-balances approach to complement automation.

Computers, for example, are invaluable for processing orders, directing shipments, and indicating "buy" when stock levels reach reordering points. However, they lack a few characteristics supply management desperately needs. Computers do not have the capability to rationalize, to analyze. Their decisions are based on data given and they do not take into consideration world conditions and peculiar operational requirements. Consequently, the computer's ability to analyze and to predict customer demands accurately is limited.

Additionally, computers are impersonal, unsympathetic, unable to

console the customer who has a supply problem. In any business, whether it is manufacturing, sales, or logistics, customer relations have tangible value.

Here is where the supply specialist and the concept of "intensified and personalized management" enter. The supply expert can review data provided by the computer and rationally make the final decision as to whether or not to reorder a product. The degree and frequency of his analysis, of course, depends entirely on the item involved. On certain commodities where the investment and use is great, he intensifies his review and screens product information almost continuously. With his experience and careful analysis of the facts, the supply specialist can anticipate how much materiel the customer will need in coming months and have stock ready in the bin when requisitions for supplies are received.

Also important to supply management, the specialist is quite personal in his dealings—a soft shoulder, if you will, on which the customer may deposit his problems. He recognizes that not every transaction is routine. A certain number of requisitions do depart from the supply blueprint. In such instances, particularly when the supply situation is critical, the human —the "personalized management approach"—proves himself.

To accommodate such knotty problems as top priority requisitions delayed because of no bin stock, DESC employs its own "special forces team" which assumes command of an order immediately and stays with it until filled. In both the item management and purchasing areas, some of the center's most experienced supply and procurement experts have been assembled—separate from the regular force—to handle these special assignments.

The team aptly demonstrated its value last December when handed the following SOS.:

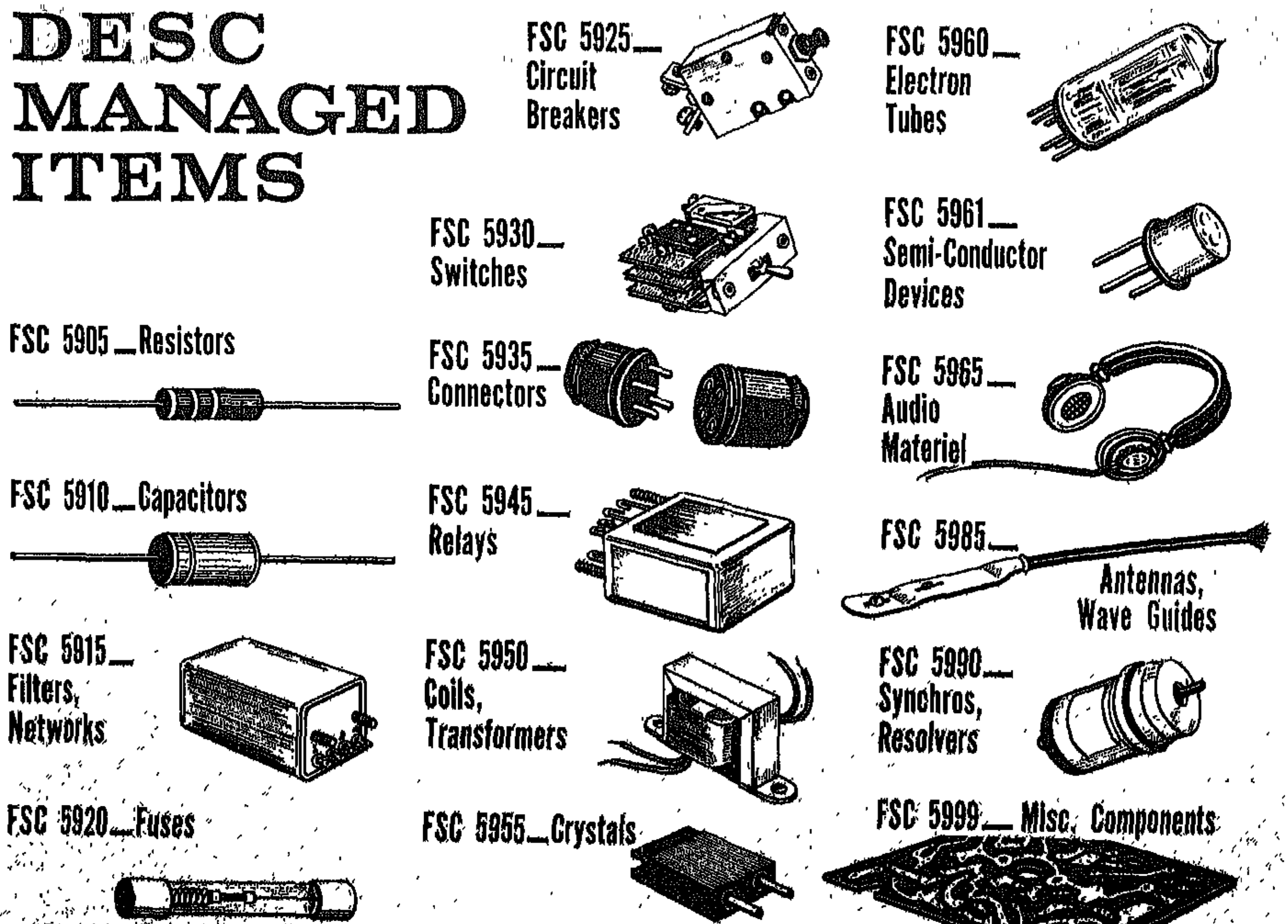
> "Request improvement in delivery. . . materiel urgently needed to support Apollo 8 mission scheduled for launch 21 December 1968."

The message, regarding two antennas, was dispatched by Patrick AFB, Fla., and reached DESC at 4 p.m. December 9. It demanded delivery by December 12.

Item management and procurement specialists immediately huddled over the matter and discovered that a contract had just been let for a number of the antennas. However, there were two problems. First, the award was still in the mail and had not reached the contractor; second, the contract contained a requirement for preproduction testing which would require 30 days to complete.

A DESC engineer was called in to resolve the testing technicality. He talked with Patrick AFB officials on the item application and all agreed that, under the pressing circumstances, the requirement could be waived.

The procurement representative then contacted the company president who, when advised of the urgency, volunteered his firm's total cooperation even though the award had not been formally received. Thus, swift attention by DESC personnel and special effort by industry had the antennas at Patrick AFB on time—in



fact, one day ahead of the deadline.

The Apollo incident noticeably points out how industry support has helped DESC's reaction capability. Since the center must totally respect the requests of its customers; it, in turn, often places heavy, sometimes inconvenient, demands on its vendors and suppliers. But the cooperation of the electronics industry has never faltered. It has remained steadfast throughout such periods as the Cuban Crisis and the Vietnam buildup. Industry support certainly is one reason why DESC is able to maintain its reputation as a responsive supplier.

Reliability Program

While getting materiel swiftly to the customer is critical, DESC does not overlook the fact that the item must be reliable. Obviously all the investment in a responsive supply system is nullified if the part fails to do its job. Therefore, reliability shares center stage with supply responsiveness at DESC.

The center employs several approaches to assure that its products function satisfactorily. Most of the attention is concentrated in the Directorate of Engineering Standardization, the only organization of its type within the Defense Supply Agency.

Currently, the directorate administers the Defense Department Standardization Program for DESC-managed classes and serves as the standardization assignee activity for DSA. Specifically, as agent for the Military Services, it prepares and coordinates specifications and standards on electronic parts among the Military Departments to assure that item requirements are sufficient to meet the needs of all intended users. It also administers the DOD Qualification Program which requires firms, interested in receiving DESC contracts, to demonstrate that they have both the facilities and capability to produce quality hardware.

The Directorate of Engineering Standardization is additionally involved in keeping pace with the progressive state of the art and new generations of electronic items. It maintains leverage on advancing technology by preparing and maintaining the Established Reliability series of specifications. These documents describe components in terms of established failure rates, and specify large-scale life testing under much more rigorous conditions than those required by conventional specifications.

Engineer Standardization engineers also serve on Parts Control Boards (PCBs) as advisers to the Air Force. The PCBs, which select parts to be used in the design of new systems, consist of representatives from industry, the Air Force and DESC.

The Directorate of Technical Operations represents another area having a sizeable investment in DESC's reliability program. Skilled technicians and engineers in this directorate study failure reports to resolve problems and, frequently, recommend redesign of components to improve quality and lower procurement costs.

Though the past seven years have been banner ones in terms of increased business for DESC, the future promises even greater expansion as each technological advancement brings greater sophistication to the equipment used by center customers. Also further refinements in systems and procedures, particularly in item management and depot operations, can be expected to match the growing demands on the center to provide a larger volume and larger variety of electronic parts.

We are indeed fortunate at DESC to have personnel with a high level of logistics experience, in excess of 18 years, who are capable of and willing to accept the challenges inherent in a rapidly expanding workload and who are determined to do their very best.

Bibliography

(Continued from page 35)

Characterization and Interpretation to Failure-Safe Design for Structural Titanium Alloys. Naval Research Laboratory, Washington, D.C., Dec. 1968, 29 p. Order No. AD–681 043.

Fuel Cell Manpack Power Source. U.S. Army Electronics Command, Fort Monmouth, N.J., Nov. 1968, 26 p. Order No. AD–680 894.

Helicopter Engines and Rotors. Defense Documentation Center, Alexandria, Va., Nov. 1968, 247 p. Order No. AD–680 200.

DOD Procurement Conference Dates Set Through October

The summer series of the Procure- ment Conference Program has beer announced by the Defense Depart ment.

Intended to develop additional com- petitive sources to meet defense re quirements, the program will provid single locations for businessmen an potential contractors to becom acquainted with the Federal procure ment and contract process.

Business representatives will hav the opportunity to meet with spe cialists on business opportunitie from the Military Services, the De fense Supply Agency and civilia agencies. Counseling will be held o the activities of the Defense Contrac Administration Services, the Defens Documentation Center, the Defens Specifications Center and other DO organizations concerned with prim and subcontracting.

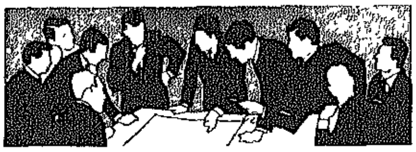
At the conferences will be $50 mil lion to $75 million in current Invita tions for Bids and Requests for Pr posals, including a number of sma purchase ($2,500 and under) pac ages. These will be on hand wit Army, Navy, Air Force and Defens Supply Agency counselors.

Dates and locations for the co ferences are: May 29, El Paso, Tex June 6, Tuscaloosa, Ala.; June 18–1 Anaheim, Calif.; June 23–24, Mi waukee, Wis.; July 25, Oshkos Wis.; Sept. 16–18, Charleston, V Va.; Oct. 13–15, Washington, D.C Oct. 29, Tucson, Ariz.; Oct. 3 Pheonix, Ariz.

Army Display To Aid Labor Surplus Areas

In an effort to assist small busine firms and both large and small fir in labor surplus areas, the Arm Electronics Command has opened display of electronic items within t production capabilities of such firm

The display, located at the Phil delphia Procurement Division, 2 S. 18th St., Philadelphia, is open all representatives of industry, whe they can examine the items and lea how they may participate in the pr gram.



MEETINGS AND SYMPOSIA

MAY

Sixth Annual Licensing Opportunity Day, May 21, at the Lower Level of the Chamber Building, 404 S. Bixel St., Los Angeles, Calif. Sponsor: Los Angeles Area Chamber of Commerce. Contact: Lee Pitt, Manager, Aerospace Department, Los Angeles Area Chamber of Commerce, 404 S. Bixel St., Los Angeles, Calif. 90054, phone (213) 482-4010, Ext. 242.

System Performance Effectiveness Meeting, May 21-22, at West Auditorium, Department of State, 23rd and C Sts., N.W., Washington, D.C. Sponsor: Naval Material Command. Contact: George W. Neumann, Executive Secretary, SPE Steering Committee, Naval Ship Systems Command, Code 03511, Washington, D.C. 20360, phone (202) OXford 6-3097.

Second Advanced Marine Vehicles and Propulsion Meeting (Confidential), May 21-23, Seattle Center, Seattle, Wash. Sponsor: American Institute of Aeronautics and Astronautics. Contact: Meetings Department, American Institute of Aeronautics and Astronautics, 1290 Sixth Ave., New York, N.Y. 10019.

Second Chemical and Molecular Lasers Conference, May 22-24, at Chase-Park Plaza Hotel, St. Louis, Mo. Sponsors: Air Force Office of Scientific Research, Optical Society of America and McDonnell Douglas Corp. Contact: Capt. John F. Kantak, Air Force Office of Scientific Research, 1400 Wilson Blvd., Arlington, Va. 22209, phone (202) OXford 4-5518.

JUNE

Pattern Recognition Studies Meeting, June 9-10, New York, N.Y. 'ponsors: U.S. Army Materiel Com-and and the Society of Photo-Opti-l Instrumentation Engineers, Con-:t: H. Handler, Technical Relations lvisor, U.S. Army Materiel Com-and, Washington, D.C. 20315, phone !02) OXford 7-6697.

Special Function and Wave Propa-on Meeting, June 10-12 at Shore-Hotel, Washington, D.C. Sponsors: Air Force Office of Scientific Research and the Society for Industrial and Applied Mathematics. Contact: Lt. Col. Paul J. Daily, Air Force Office of Scientific Research, 1400 Wilson Blvd., Arlington, Va. 22209, phone (202) OXford 4-5261.

Planning Challenges of the 1970s in Space and the Public Domain Meeting, June 17-20, at the Brown Palace Hotel, Denver, Colo. Sponsors: American Astronautics Society and the Operations Research Society of America. Contact: Dr. George W. Morgenthaler, General Program Chairman, Martin Marietta Corp., P.O. Box 179, Denver, Colo. 80201, phone (303) 794-5211, Ext. 4557.

Electromagnetic Compatibility Symposium, June 19-20, at Fort Monmouth, N.J. Sponsor: Department of the Army. Contact: Gilbert C. Josephson, Office of the Assistant Chief of Staff for Communications-Electronics, Attn: CEFM-561, Department of the Army, Washington, D.C. 20315, phone (202) OXford 5-7221.

JULY

Sixth International Physics of Electronics and Atomic Collision Conference, July 27-Aug. 2, Massachusetts Institute of Technology, Cambridge, Mass. Sponsors: Air Force Office of Scientific Research, Massachusetts Institute of Technology, Office of Naval Research, National Science Foundation, International Union of Pure and Applied Sciences, and the Army Research Office, Durham, N.C. Contact: D.W. Wennersten, Air Force Office of Scientific Research (SRPP), 1400 Wilson Blvd., Arlington, Va. 22209, phone (202) OXford 4-5454; or Dr. Robert Mace, Director, Physics Division, U.S. Army Research Office-Durham, Box CM, Duke Station, Durham, N.C. 27706, phone (919) 286-2285.

AUGUST

Eleventh International Botanical Congress, August (dates not yet determined) at the University of Wasl ington, Seattle, Wash. Sponsor: A Force Office of Aerospace Researc Contact: Dr. Harvey Savely, A Force Office of Scientific Researc 1400 Wilson Blvd., Arlington, V 22209, phone (202) OXford 4-504 or Dr. John R. Olive, Execu tive Director, American Institute (Biological Sciences, 3900 Wiscons Ave. N.W., Washington, D.C. 2001

Third Inequalities Symposium, Au ust (dates not yet determined) Un versity of California, Los Angele Calif. Sponsor: Air Force Office (Scientific Research, California Un versity and the Aerospace Researc Laboratories. Contact: Dr. R. (Pohrer, Air Force Office of Scientifi Research, (SRMM) 1400 Wilso Blvd., Arlington, Va. 22209, phor (202) OXford 4-5264.

Topology of Manifolds, Aug. 4-1 at the University of Georgia, Athen Ga. Sponsor: Air Force Office (Scientific Research and the Unive sity of Georgia. Contact: Dr. R.C Pohrer, Air Force Office of Scientifi Research (SRMM), 1400 Wilso Blvd., Arlington, Va. 22209, phon (202) OXford 4-5264.

International Conference on Scienc of Superconductivity, Aug. 26-2 Stanford University, Stanford, Cali Sponsor: Air Force Office of Scienti fic Research. Contact: Lt. Col. R.A Houidobre, Air Force Office o Scientific Research (SRPS), 140 Wilson Blvd., Arlington, Va. 2220 phone (202) OXford 4-5588; o Prof. W.M. Fairbank, Stanford Uni versity, W. W. Hanson Laboratory o Physics, Stanford, Calif., phon (415) 327-7800.

Third International Biophysic Congress, Aug. 29-Sept. 3, at Cam bridge, Mass. Sponsor: Air Forc Office of Aerospace Research. Con tact: Dr. R.V. Brown, Air Forc Office of Scientific Research (SRLA) 1400 Wilson Blvd., Arlington, Va 22209, phone (202) OXford 4-5042 or Prof. Walter Rosenblith, Dept. o Electrical Engineering, Massachu setts Institute of Technology, Cam bridge, Mass.

Status of Funds Quarterly Report

Outlays

Second Quarter, Fiscal Year 1969

(Thousands of Dollars)

›partment of Defense

	Outlays				Unpaid obligations	
	October 1968	November 1968	December 1968	Cum thru 31 Dec. 1968	At start of year	As of 31 Dec. 1968
litary Personnel						
Active forces	1,767,306	1,668,329	1,826,295	10,144,630	761,917	868,599
Reserve forces	75,132	61,903	63,381	495,925	149,746	121,970
Retired pay	197,931	198,893	201,133	1,175,983	6,880	6,747
Undistributed	−12,066	−14,035	−124,993	−148,964	—	148,964
Total—Military Personnel	2,028,302	1,915,090	1,965,816	11,667,524	918,543	1,146,280
eration and Maintenance	1,696,547	1,863,881	2,036,454	10,703,720	4,033,198	4,298,515
curement						
Aircraft	784,237	782,060	775,916	4,697,075	9,591,226	8,450,402
Missiles	225,963	199,659	219,781	1,160,070	2,069,735	2,608,756
Ships	183,744	158,151	157,511	935,273	3,447,418	3,392,563
Tracked combat vehicles	46,495	42,717	42,797	218,606	610,190	593,948
Ordnance, vehicles and related equipment	514,536	535,510	541,010	2,702,685	6,595,867	8,388,703
Electronics and communications	133,244	122,637	111,866	697,846	1,881,394	1,649,372
Other procurement	189,198	175,938	82,120	899,109	2,056,183	2,035,476
Undistributed	3,161	−1,372	53,737	394,055	−7,225	−401,485
Total—Procurement	2,080,577	2,014,705	1,984,727	11,704,720	26,244,228	26,657,788
search, Development, Test, & Evaluation						
Military sciences	77,712	79,545	71,245	407,374	777,774	744,419
Aircraft	88,030	107,851	99,849	476,246	717,451	693,759
Missiles	225,163	199,979	199,783	1,149,943	983,018	1,424,582
Astronautics	101,841	109,738	90,964	632,169	487,480	543,766
Ships	28,639	23,064	25,090	149,969	245,279	340,262
Ordnance, vehicles and related equipment	29,182	31,448	25,848	152,313	216,577	273,888
Other equipment	71,803	58,196	57,286	358,800	478,981	581,213
Program-wide management and support	38,377	26,894	49,098	292,925	189,338	214,648
Undistributed	−7,620	−4,236	9,678	−9,588	−1,639	7,248
Total—Research, Development, Test, & Evaluation	653,128	632,470	628,841	3,670,152	4,094,265	4,778,775
litary Construction	139,414	124,774	130,901	674,864	1,784,255	1,858,362
nily Housing	45,928	44,281	46,427	264,045	174,687	237,798
il Defense	7,040	7,334	8,382	44,625	80,629	65,497
ier—Special Foreign Currency Program	272	107	99	715	1,071	490
volving and Management Funds	94,272	−243,283	−89,942	−537,369	6,078,411	7,079,014
Subtotal—Military Functions—Federal Funds	6,746,481	6,369,358	6,711,704	38,182,904	43,409,287	46,117,466
litary Assistance—Federal Funds	56,461	42,830	8,143	248,968	1,823,034	1,611,206
Grand Total—Federal Funds	6,801,942	6,402,188	6,719,847	38,431,872	45,232,322	47,728,672
Total—Military Funcations-Bud. Concept adj.	−7,922	−23,571	−9,345	−68,369	8,794	2,636
Total—Military Assistance-Bud. Concept adj.	22,149	36,047	−31,099	142,756	433,454	224,812
Grand Total—Budget Concept adjustments	14,227	12,477	−40,445	74,387	442,248	227,449
TOTAL—DEPARTMENT OF DEFENSE	6,816,169	6,414,664	6,679,403	38,506,259	45,674,570	47,956,121

›partment of the Army

	October 1968	November 1968	December 1968	Cum thru 31 Dec. 1968	At start of year	As of 31 Dec. 1968
litary Personnel						
Active forces	719,582	679,321	828,074	4,151,606	382,077	362,294
Reserve forces	49,893	40,348	42,743	340,525	112,578	81,745
Undistributed	30,105	−6,003	−148,995	−200,056	—	200,056
Total—Military Personnel	799,580	713,666	721,822	4,292,075	494,654	644,095
eration and Maintenance	695,366	703,995	860,498	4,108,186	1,541,708	1,283,818
curement						
Aircraft	92,318	102,885	106,972	558,878	1,343,518	1,205,566
Missiles	52,828	41,992	48,189	259,036	629,712	1,028,969
Tracked combat vehicles	37,744	42,203	41,803	206,703	586,046	512,760
Ordnance, vehicles, and related equipment	193,574	256,191	289,247	1,243,806	3,445,481	4,498,275
Electronics and communications	53,808	46,808	41,525	221,808	688,774	613,288
Other procurement	49,204	41,448	43,489	242,542	769,510	655,839
Undistributed	12,681	−4,823	34,760	385,586	−7,225	−398,029
Total—Procurement	491,657	529,703	599,932	3,118,420	7,465,816	8,111,113
earch, Development, Test, & Evaluation						
Military sciences	10,397	7,746	8,968	55,042	98,272	109,856
Aircraft	8,128	6,390	6,777	49,257	78,199	92,254
Missiles	56,178	57,381	57,544	319,218	386,366	524,958
Astronautics	908	857	1,255	5,148	7,865	5,168
Ordnance, vehicles, and related equipment	14,977	14,659	12,062	78,180	110,532	125,918
Other equipment	29,960	31,984	26,758	164,858	196,748	198,437
Program-wide management and support	8,581	7,007	7,694	45,402	33,898	38,122
Undistributed	−2,095	−6,059	5,006	18,478	−1,633	−20,823
Total—Research, Development, Test, & Evaluation	127,030	119,974	126,064	736,583	910,247	1,073,885
itary Construction	45,368	43,485	32,440	212,783	768,046	789,846
olving and Management Funds	6,098	−68,285	−23,706	−18,892	1,955,905	1,869,930
ny—Federal Funds	2,165,089	2,042,538	2,307,049	12,448,104	13,126,377	13,772,688
ny—Budget Concept adjustments	−5,546	−18,973	−4,493	−36,036	10	−315
TOTAL—DEPARTMENT OF THE ARMY	2,159,544	2,023,565	2,302,556	12,412,068	13,126,387	13,772,373

Department of the Navy

	Outlays				Unpaid obligations	
	October 1968	November 1968	December 1968	Cum thru 31 Dec. 1968	At start of year	As of 31 Dec. 1968
Military Personnel						
Active forces	522,167	480,107	506,629	2,935,170	225,093	275,62
Reserve forces	12,281	10,271	10,091	75,485	22,898	26,01
Undistributed	−45,758	2,078	19,471	26,785	—	−26,73
Total—Military Personnel	488,690	492,456	536,191	3,037,340	247,991	274,91
Operation and Maintenance	821,465	505,469	529,925	2,749,209	1,466,352	1,689,37
Procurement						
Aircraft	235,593	227,881	242,051	1,418,672	3,218,049	2,890,42
Missiles	43,149	38,835	53,482	238,675	547,934	746,53
Ships	183,744	158,151	157,511	935,273	3,447,418	3,392,56
Tracked combat vehicles	8,751	514	994	11,903	24,144	21,18
Ordnance, vehicles, and related equipment	180,882	132,512	109,771	742,143	1,713,984	1,892,00
Electronics and communications	42,999	39,863	38,323	254,525	645,301	580,77
Other procurement	119,095	85,878	55,208	429,830	1,143,225	1,239,80
Undistributed	−9,942	−558	20,846	16,878	—	−16,87
Total—Procurement	804,270	683,082	678,185	4,042,900	10,740,005	10,746,41
Research, Development, Test, & Evaluation						
Military sciences	17,152	18,781	12,326	94,062	121,458	153,19
Aircraft	37,724	34,450	26,690	175,546	257,524	244,27
Missiles	57,944	53,665	53,027	349,891	258,025	495,12
Astronautics	1,416	1,703	1,562	9,514	16,259	20,21
Ships	28,639	28,054	25,090	149,969	245,279	340,26
Ordnance, vehicles, and related equipment	14,205	16,789	13,786	74,133	106,045	147,96
Other equipment	10,786	9,900	9,318	57,583	79,604	105,18
Program-wide management and support	8,978	−2,281	20,097	111,670	133,064	136,22
Undistributed	−2,983	1,121	6,737	7,388	—	−7,35
Total—Research, Development, Test, & Evaluation	173,860	157,182	168,683	1,029,256	1,217,258	1,575,06
Military Construction	46,633	26,796	52,053	210,178	573,575	675,74
Revolving and Management Funds	124,003	−104,420	−66,686	−165,656	2,269,078	2,329,35
Navy—Federal Funds	1,958,921	1,760,566	1,898,301	10,897,228	16,514,258	17,290,85
Navy—Budget Concept adjustments	895	−1,981	−3,345	−18,342	110	36
TOTAL—DEPARTMENT OF THE NAVY	1,959,816	1,758,585	1,894,956	10,878,886	16,514,368	17,291,21

Department of the Air Force

Military Personnel						
Active forces	525,567	508,901	491,592	3,057,854	154,747	230,67
Reserve forces	12,958	11,284	10,547	79,965	14,270	14,20
Undistributed	3,587	−10,110	4,531	24,357	—	−24,35
Total—Military Personnel	542,102	510,075	506,670	3,162,176	169,017	220,52
Operation and Maintenance	598,123	568,988	561,905	3,313,866	927,881	1,210,55
Procurement						
Aircraft	456,326	451,201	426,893	2,724,525	5,029,659	4,854,41
Missiles	130,486	115,832	118,160	662,859	892,080	838,25
Ordnance, vehicles, and related equipment	139,449	146,557	147,889	714,416	1,434,835	2,002,86
Electronics and communications	36,005	35,465	30,709	216,462	539,008	449,69
Other procurement	19,632	44,477	−20,136	210,584	100,001	100,04
Undistributed	297	3,794	−3,303	−10,264	—	10,27
Total—Procurement	782,193	797,419	700,209	4,518,080	7,995,592	7,766,53
Research, Development, Test, & Evaluation						
Military sciences	12,971	12,807	10,795	76,193	104,162	108,53
Aircraft	42,178	67,002	66,382	251,443	381,728	357,22
Missiles	111,046	88,933	89,212	481,334	388,627	464,49
Astronautics	99,517	107,178	88,147	617,507	463,856	518,38
Other equipment	31,058	16,312	21,210	136,359	202,629	227,59
Program-wide management and support	20,818	22,168	21,807	135,853	22,376	40,30
Undistributed	−2,542	702	−2,065	−35,454	—	35,45
Total—Research, Development, Test, & Evaluation	315,046	315,103	294,988	1,668,236	1,512,878	1,751,98
Military Construction	46,213	53,750	45,613	247,545	425,858	378,52
Revolving and Management Funds	−51,324	−65,372	−17,773	−229,584	521,170	1,713,36
Air Force—Federal Funds	2,227,353	2,179,962	2,091,612	12,675,368	11,552,396	13,030,48
Air Force—Budget Concept adjustments	−3,055	−2,607	−1,514	−13,983	8,675	2,34
TOTAL—DEPARTMENT OF THE AIR FORCE	2,224,298	2,177,355	2,090,098	12,661,385	11,561,071	13,032,83

Defense Agencies/Office of the Secretary of Defense	Outlays				Unpaid obligations	
	October 1968	November 1968	December 1968	Cum thru 31 Dec. 1968	At start of year	As of 31 Dec. 19
Military Personnel						
Retired Pay	197,931	198,893	201,133	1,175,983	6,880	6,7
Operation and Maintenance	86,598	85,429	94,126	538,509	97,258	114,7
Procurement						
Ordnance, vehicles, and related equipment	631	250	103	2,261	1,117	5
Electronics and communications	432	501	1,299	5,051	8,251	5,6
Other procurement	1,267	3,535	3,565	16,153	43,447	40,2
Undistributed	128	215	1,434	1,855	—	−1,8
Total—Procurement	2,457	4,502	6,401	25,320	52,815	44,6
Research, Development, Test, & Evaluation						
Military sciences	37,192	40,211	39,156	242,077	453,882	372,8
Military Construction	1,205	743	794	4,357	16,777	14,2
Family Housing	45,928	44,281	46,427	254,045	174,687	237,7
Other—Special Foreign Currency Program	272	107	99	715	1,071	4
Revolving and Management Funds	15,500	−5,207	18,223	−123,277	1,332,258	1,166,3
Defense Agencies—Federal Funds	387,078	368,958	406,360	2,117,679	2,135,628	1,957,9
Defense Agencies—Budget Concept adjustments	−217	−9	6	−8	—	2
TOTAL—DEFENSE AGENCIES	386,861	368,948	406,366	2,117,671	2,135,628	1,958,1

Office of Civil Defense

Civil Defense	7,040	7,334	8,382	44,525	80,629	65,49
Revolving and Management Funds	—	—	—	—	—	—
TOTAL—OFFICE OF CIVIL DEFENSE-FED. FUNDS	7,040	7,334	8,382	44,525	80,629	65,49

Military Assistance

Military Personnel	28	15	12	122	358	26
Operation and Maintenance	18,606	16,305	14,231	108,940	230,840	212,98
Procurement						
Aircraft	8,123	5,974	7,879	46,996	226,880	194,71
Missiles	1,271	388	444	2,288	16,035	18,54
Ships	2,678	322	−160	4,506	48,984	84,22
Ordnance, vehicles, and related equipment	10,146	14,620	3,788	56,438	192,738	171,34
Electronics and communications	4,330	3,011	1,769	29,998	101,235	92,24
Other procurement	3,786	1,269	1,292	18,499	88,420	88,04
Total—Procurement	30,334	25,584	15,012	158,725	669,292	644,11
Research, Development, Test, & Evaluation	10	−10	10	10	35	4
Military Construction	23	19	50	935	6,809	5,96
Revolving Fund	3,726	2,877	−19,584	5,694	848,233	745,98
Undistributed	3,736	−1,963	−1,588	−25,459	67,472	1,89
Subtotal—Military Assistance	56,461	42,830	8,143	248,968	1,823,034	1,611,20
Total—Military Assistance-Budget Concept adjustments	22,149	36,047	−31,099	142,756	433,464	224,81
TOTAL—MILITARY ASSISTANCE	78,610	78,877	−22,957	391,723	2,256,408	1,836,01

Obligations

Department of Defense	Available for Obligation	Obligations				Unobligated balance 31 Dec. 1968
		October 1968	November 1968	December 1968	Cum thru 31 Dec. 1968	
Military Personnel						
Active forces	19,576,230	1,768,187	1,680,555	1,694,548	10,428,496	9,147,784
Reserve forces	909,786	65,407	62,218	56,476	459,458	450,828
Retired pay	2,275,000	197,876	199,080	201,312	1,175,489	1,099,511
Total—Military Personnel	22,761,016	2,031,471	1,941,852	1,952,336	12,063,443	10,697,578
Operation and Maintenance	23,698,730	2,308,955	1,605,976	1,675,713	12,095,286	11,603,449
Procurement						
Aircraft	11,588,998	534,958	545,971	899,508	3,823,757	7,765,241
Missiles	4,190,429	238,553	213,778	230,201	1,763,691	2,426,738
Ships	3,635,059	146,733	94,734	143,098	920,139	2,714,920
Tracked combat vehicles	459,581	52,774	13,946	23,997	171,427	288,154
Ordnance, vehicles, and related equipment	10,203,648	1,002,203	774,060	384,019	5,512,854	4,690,794
Electronics and communications	2,357,000	108,693	95,503	94,842	556,874	1,800,126
Other procurement	3,355,778	191,121	185,444	102,915	1,072,311	2,283,467
Undistributed	−420,303	—	—	—	—	−420,303
Total—Procurement	35,370,189	2,275,038	1,923,483	1,878,577	13,821,053	21,549,136
Research, Development, Test, & Evaluation						
Military sciences	1,278,041	71,499	73,084	77,748	475,243	802,798
Aircraft	1,128,992	−9,280	98,978	57,886	454,155	674,837
Missiles	2,620,125	248,576	118,232	141,676	1,639,984	980,141
Astronautics	1,306,808	181,883	82,754	97,719	727,548	579,260
Ships	431,702	21,897	27,069	31,410	256,260	175,442
Ordnance, vehicles, and related equipment	399,151	20,036	16,354	25,487	210,508	188,643
Other equipment	1,024,325	70,070	48,899	53,167	418,547	605,778
Program-wide management and support	1,133,839	69,682	95,043	68,201	477,852	655,987
Emergency Fund	—	—	—	—	—	—
Undistributed	79,293	—	—	—	—	79,293
Total—Research, Development, Test, & Evaluation	9,402,278	674,363	555,413	559,298	4,660,100	4,742,178
Military Construction	3,528,773	173,972	161,496	133,712	952,766	2,576,007
Family Housing	757,467	60,655	41,190	52,288	321,639	435,828
Civil Defense	69,206	8,891	7,181	7,519	30,608	38,598
Other	15,742	−20	88	2	134	15,608
Subtotal—Military Functions	95,603,401	7,527,826	6,236,623	6,253,446	43,945,030	51,658,371
Military Assistance	682,001	12,499	1,088	17,999	135,616	546,885
TOTAL—DEPARTMENT OF DEFENSE	96,285,402	7,540,327	6,237,709	6,271,445	44,080,645	52,204,756

Department of the Army

	Available for Obligation	Obligations October 1968	Obligations November 1968	Obligations December 1968	Obligations Cum thru 31 Dec. 1968	Unobligated balance 31 Dec. 1968
Military Personnel						
Active forces	8,094,634	719,484	675,538	686,658	4,263,079	3,831,555
Reserve forces	593,600	45,921	39,178	36,339	301,065	292,535
Total—Military Personnel	8,688,234	765,405	714,716	722,997	4,564,144	4,124,090
Operation and Maintenance	8,879,625	803,769	656,535	632,676	4,405,763	4,473,861
Procurement						
Aircraft	1,217,329	35,215	68,120	38,657	430,878	786,451
Missiles	1,118,573	62,900	103,486	68,855	694,738	423,835
Tracked combat vehicles	429,245	49,918	14,430	23,875	162,480	266,765
Ordnance, vehicles, and related equipment	5,789,273	518,346	491,096	232,586	3,303,161	2,486,112
Electronics and communications	944,654	31,074	27,499	27,772	200,921	743,733
Other procurement	846,137	38,047	36,594	14,014	163,113	682,724
Undistributed	−436,850	—	—	—	—	-435,850
Total—Procurement	9,909,861	785,500	741,225	405,759	4,955,591	4,953,770
Research, Development, Test, & Evaluation						
Military sciences	203,515	15,618	14,050	12,776	97,142	106,373
Aircraft	160,821	9,103	7,179	12,294	64,647	96,174
Missiles	785,399	35,770	27,749	42,568	459,926	325,473
Astronautics	12,138	609	319	345	2,459	9,679
Ordnance, vehicles, and related equipment	211,114	11,261	4,894	12,886	94,412	116,702
Other equipment	483,265	27,708	25,454	22,741	169,262	311,003
Program-wide management and support	100,701	5,770	7,023	5,113	50,948	49,753
Undistributed	−4,021	—	—	—	—	4,021
Total—Research, Development, Test, & Evaluation	1,952,932	105,839	86,668	109,023	938,796	1,014,136
Military Construction	1,539,593	52,169	58,350	66,823	357,680	1,181,913
TOTAL—DEPARTMENT OF THE ARMY	30,969,745	2,462,682	2,257,194	1,937,278	15,221,974	15,747,771

Department of the Navy

	Available for Obligation	Obligations October 1968	Obligations November 1968	Obligations December 1968	Obligations Cum thru 31 Dec. 1968	Unobligated balance 31 Dec. 1968
Military Personnel						
Active forces	5,763,804	515,018	486,164	497,867	3,011,701	2,752,103
Reserve forces	156,256	9,294	10,827	11,296	78,155	78,101
Total—Military Personnel	5,920,060	524,312	496,991	509,163	3,089,856	2,830,204
Operation and Maintenance	6,491,067	889,144	532,924	341,999	3,322,081	3,168,386
Procurement						
Aircraft	3,514,333	296,795	165,593	387,672	1,113,251	2,401,082
Missiles	998,799	15,418	35,928	26,782	450,969	547,830
Ships	3,635,059	146,733	94,734	143,098	920,139	2,714,920
Tracked combat vehicles	30,336	2,856	−484	122	8,947	21,389
Ordnance, vehicles, and related equipment	2,231,725	297,506	238,421	80,865	925,545	1,306,180
Electronics and communications	791,153	57,932	28,567	43,422	195,404	595,749
Other procurement	1,929,356	139,009	102,704	72,203	680,709	1,248,647
Undistributed	−137,077	—	—	—	—	137,077
Total—Procurement	12,993,682	956,250	665,463	754,166	4,294,966	8,698,720
Research, Development, Test, & Evaluation						
Military sciences	292,464	16,031	13,326	18,844	129,012	163,452
Aircraft	422,856	16,064	21,614	5,491	162,411	260,445
Missiles	769,548	41,049	26,296	42,373	537,737	231,811
Astronautics	25,053	8,806	6,904	−4,042	13,539	11,514
Ships	431,702	21,897	27,069	31,410	256,260	175,442
Ordnance, vehicles, and related equipment	188,037	8,775	11,460	12,601	116,096	71,941
Other equipment	137,386	15,871	6,337	7,866	84,401	52,985
Program-wide management and support	749,002	42,117	65,994	42,254	265,752	483,250
Undistributed	301	—	—	—	—	301
Total—Research, Development, Test, & Evaluation	3,016,349	165,610	179,000	156,797	1,565,208	1,451,141
Military Construction	1,309,757	90,006	54,580	44,133	391,407	918,350
TOTAL—DEPARTMENT OF THE NAVY	29,730,915	2,625,322	1,928,909	1,806,258	12,664,119	17,066,796

t of the Air Force

	Available for Obligation	Obligations October 1968	Obligations November 1968	Obligations December 1968	Obligations Cum thru 31 Dec. 1968	Unobligated balance 31 Dec. 1968
iel						
s	5,717,792	533,685	518,853	510,023	3,153,716	2,564,076
ces	159,930	10,192	12,213	8,841	80,238	79,692
Military Personnel	5,877,722	543,878	531,065	518,864	3,233,954	2,643,768
Maintenance	7,204,552	511,528	329,498	612,581	3,790,438	3,414,115
	6,857,336	202,948	312,258	473,174	2,279,628	4,577,708
	2,073,057	160,285	74,364	134,564	617,984	1,455,073
	—	—	—	—	—	—
'ehicles, and related equipment	2,179,760	185,935	44,360	70,828	1,282,443	897,317
and communications	611,190	19,563	38,068	23,505	158,081	453,109
irement	482,056	12,380	42,092	15,238	210,625	271,431
ed	128,526	—	—	—	—	128,526
-Procurement	12,331,926	581,064	512,138	716,809	4,548,759	7,783,168
opment, Test, & Evaluation						
ences	194,800	13,437	12,680	10,829	86,843	107,957
	545,315	-34,447	70,185	40,101	227,097	318,218
	1,065,178	171,757	59,187	56,735	642,321	422,857
s	1,269,617	177,468	75,531	101,416	711,550	558,067
ment	403,674	26,491	17,108	22,560	164,884	238,790
de management and support	284,136	21,795	22,026	20,534	161,152	122,984
ed	83,013	—	—	—	—	83,013
-Research, Development, Test, & Evaluation	3,845,735	376,500	256,718	252,178	1,993,849	1,851,886
uction	573,167	31,806	48,960	22,330	201,842	371,325
DEPARTMENT OF THE AIR FORCE	29,833,102	2,044,775	1,678,360	2,122,762	13,768,842	16,064,259

gencies/Office of the tary of Defense

	Available for Obligation	October 1968	November 1968	December 1968	Cum thru 31 Dec. 1968	Unobligated balance 31 Dec. 1968
nel						
,	2,275,000	197,876	199,080	201,312	1,175,489	1,099,511
Maintenance	1,123,486	104,515	87,018	88,458	576,405	547,081
vehicles, and related equipment	2,890	416	183	240	1,705	1,185
and communications	10,003	124	1,369	143	2,468	7,535
irement	98,229	1,685	3,064	1,460	17,564	80,665
ed	24,098	—	—	—	—	24,098
-Procurement	135,220	2,224	4,607	1,848	21,737	113,483
opment, Test, & Evaluation						
ences	587,262	26,413	33,028	35,299	162,246	425,016
Fund	—	—	—	—	—	—
ed	—	—	—	—	—	—
-Research, Development, Test, & Evaluation	587,262	26,413	33,028	35,299	162,246	425,016
uction	106,257	-9	-345	427	1,837	104,420
	757,467	60,655	41,190	52,288	321,639	435,828
	15,742	-20	83	2	134	15,608
DEFENSE AGENCIES/OSD	5,000,433	391,656	364,660	379,629	2,259,487	2,740,947

Civil Defense

	Available for Obligation	October 1968	November 1968	December 1968	Cum thru 31 Dec. 1968	Unobligated balance 31 Dec. 1968
	69,206	3,391	7,181	7,519	30,608	38,598

ssistance

	Available for Obligation	October 1968	November 1968	December 1968	Cum thru 31 Dec. 1968	Unobligated balance 31 Dec. 1968
nel	78	26	—	—	78	—
Maintenance	637,795	9,788	3,164	13,388	91,715	546,080
	11,593	1,095	-545	992	11,482	111
	-9	-282	-1,258	-64	-9	—
	1,801	112	44	-40	1,678	123
vehicles, and related equipment	16,839	2,654	-485	2,341	16,839	—
and communications	8,591	-504	1,809	563	8,575	16
urement	5,174	-866	-1,065	355	5,159	15
-Procurement	43,989	2,719	-1,495	4,147	43,724	265
lopment, Test, & Evaluation	—	-27	27	-27	-27	27
uction	138	—	-35	13	138	—
ed	1	-5	-506	479	-13	14
MILITARY ASSISTANCE	682,001	12,499	1,088	17,999	135,616	546,385

outlay amounts are on a net Treasury basis nents less reimbursement collections), whereas and unpaid obligations are on a gross basis of reimbursable activity performed by compo- OD for each other). Therefore, unpaid obliga- the end of the reporting month cannot be com- other figures in this report.

Prepared by:
Directorate for Financial Analysis and Control
Office of Assistant Secretary of Defense (Comptroller)
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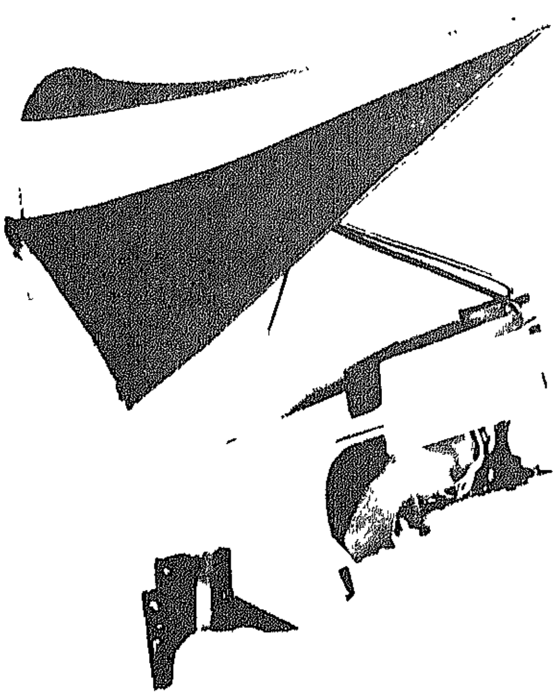


A parawing self-rescue model shown in simulated flight after ejection from a disabled aircraft.

Navy-Air Force Investigate Pilot Rescue Systems

Two aircrew self-rescue concepts, which may enable a crewman of a disabled aircraft to use his ejection seat to fly away from enemy territory, have been developed for a joint Air Force-Navy program.

Reinhold J. Gross of the Recovery and Crew Station Branch, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio, laboratory project engineer on the effort to determine capabilities of the systems, ıid models of both types have been ilt and are being evaluated.

The Air Force system is a "V" type rawing, built by the Stencel Aero ıgineering Corp., Asheville, N.C. ʼith the parawing system, a jet ngine would be ignited following jection from the aircraft, propelling he ejection seat and crewman at 85 o 90 miles per hour up to altitudes f 10,000 feet.

Maneuvering via the parawing's enter of gravity and wing bank control system, the crewman would fly to friendly territory, where he would jettison the ejection seat and rescue assembly and parachute to the ground. The parawing version weighs ·00 pounds.

Both the parawing and the Navy version, utilizing a rotor, would be packed into the back of the ejection seat.

Army Studies Aviation Needs Through 1975

How does aviation fit into the Army of 1975? And what type of aircraft and equipment will be needed?

The answers to these questions were supplied by the recent Aviation-75 Basic Derivative Study of the U.S. Army Combat Developments Command Aviation Agency, Fort Rucker, Ala.

Aviation-75 was an 18-month effort by the Aviation Agency to define operations, organizations and materiel required to support the combat arms in the next five years.

Developments foreseen for the five-year period include the greater use of heavy-lift helicopters for logistic support and a requirement for heavy-lift helicopters of even greater payload capacity. Also occurring during the period will be the introduction of the AH-56 Cheyenne attack helicopter to supplement the AH-1G Huey Cobra for support of airmobile operations.

For the study, aviation units were tailored to meet the needs of a particular threat and environment. To the basic component of the aviation battalion were added combinations of type-aviation companies to meet the needs of the supported company, such as assault helicopter companies general support companies and medium helicopter companies. As needs arose, other specialized aircraft would be required.

According to the study, all aircraft are available now or would be available during the 1970–1975 period.

Army Seeks Aviation Fireproofing Aids

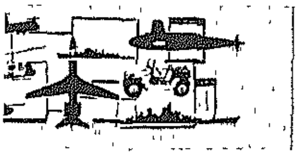
In an effort to reduce the number of casualties in aircraft accidents, the U.S. Army Aviation Agency, Combat Development Command (CDC), Fort Rucker, Ala., has called for the development of fireproof clothing for aircrewmen and crash-resistant fuel cells for aircraft.

Research has disclosed that post-crash fires caused approximately 65 percent of the fatalities in aircraft accidents. The development of the fireproof clothing and the crash-resistant fuel cell could greatly reduce the loss of personnel and equipment.

CDC envisions the cloth being used in a system of clothing, including uniforms, undergarments, socks and footwear. Requirements for the cloth specify that it should not prevent crewmen from performing normal duties even in severe temperature extremes. Reliability and maintainability of the cloth must be equal to that of current uniform materials. The ideal cloth would also be impervious to chemical and biological agents.

The crash-resistant fuel cell CDC is seeking would resist rupture and leakage as a result of an aircraft accident, and would be self-sealing when hit by a fully tumbling 14.5mm round. The cell would be designed to fit all aircraft currently in use without modification to the airframes. In addition, it would impose no limitations for use in future aircraft.

The material used in the fuel cell would be unaffected by temperature, humidity and altitude, and would be resistant to external electrical and chemical fires.



DEFENSE PROCUREMENT

of $1,000,000 and over
ng the month of March

SUPPLY AGENCY

Son Co., Vineland, N.J. $2,-
000 men's tropical wool poly-
Defense Personnel Support
adelphia, Pa. DSA 100-69-C-

at Co., Paulsboro, N.J. $1,-
00 men's tropical wool polyes-
efense Personnel Support Cen-
lphia, Pa. DSA 100-69-C-

, Inc., Atlantic City, N.J.
120,000 men's tropical wool
ats Defense Personnel Sup-
Philadelphia, Pa. DSA 100-

ies, Inc., Vineland, N.J. $1,-
)00 men's tropical wool poly-
Defense Personnel Support
ladelphia, Pa. DSA 100-69-

Clothing Co., Minotola, N.J.
125,000 men's tropical wool
ats. Defense Personnel Sup-
Philadelphia, Pa. DSA 100-

hing Co., Vineland, N.J. $1,-
)00 men's tropical wool poly-
Defense Personnel Support
ladelphia, Pa. DSA 100-69-

Oil Refineries, Long Beach,
,470. 1,260,000 barrels of num-
oil. Defense Fuel Supply Cen-
hia, Va. DSA 600-69-D-1355.
lls, New York, N.Y. $3,034,-
0 yards of camouflage printed,
nt, poplin (ripstop) cotton
se Personnel Support Center,
, Pa. DSA 100-69-C-1638.
it Products, Gastonia, N.C.
1,493,400 men's crew neck
Defense Personnel Support
lladelphia, Pa. DSA 100-69-

Industries, New York, N.Y.
362,000 yards of tropical wool
ise Personnel Support Center,
, Pa. DSA 100-69-C-1627
is & Co., New York, N.Y. $1,-
),000 yards of tropical wool
ise Personnel Support Center,
, Pa. DSA 100-69-C-1628.
ig Co., Valdosta, Ga. $1,214,-
)00 polypropylene sand bags
)0 acrylic sand bags Defense
pply Center, Richmond, Va.
-C-4683.
lustrial Bag Co., Crowley, La.
6,175,000 acrylic fiber sand
nse General Supply Center,
Va. DSA 400-69-C-4684.
l Bag Corp., Philadelphia, Pa.
10,200,000 acrylic fiber sand
nse General Supply Center,
Va. DSA 400-69-C-4685.

RACT LEGEND
nformation is listed in
ing sequence: Date—
— Value — Material or
e Performed—Location
erformed (if other than
plant) — Contracting
ontract Number.

—Cavalier Bag Co., Lumberton, N.C. $3,-546,430 13,000,000 acrylic sand bags. Defense General Supply Center, Richmond, Va. DSA 400-69-C-4686

6—A. M. Ellis Hosiery Co., Philadelphia, Pa. $1,162,816. 2,000,000 pairs of men's socks. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1636.

7—Burlington Industries, New York, N.Y. $1,008,000. 300,000 yards of serge polyester wool cloth Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1587

—Lester D. Lawson & Co., Long Beach, Calif. $1,197,100. 40,320 cases of ration supplement sundries Defense Personnel Support Center, Philadelphia, Pa. DSA 134-69-C-0772

—Van Brodie Milling Co., Clinton, Mass. $1,172,908. 40,320 cases of ration supplement sundries. Defense Personnel Support Center, Philadelphia, Pa. DSA 134-69-C-0723

12—A. G. Schoonmaker Co., Inc., Sausalito, Calif. $1,710,350. 1,013 portable self-contained floodlight sets. Defense General Supply Center, Richmond, Va. DSA 400-69-C-0217.

—Mobil Oil Corp., New York, N.Y. $4,226,-325 53,650 barrels diesel fuels and 2,275,-000 barrels No. 6 fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 100-69-D-0014.

13—Centre Manufacturing Co., Inc., Centre, Ala. $1,170,946. 121,720 men's coated nylon twill raincoats Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1734.

17—Standard Oil Co. of Calif. $2,811,800. 1,037,766 gallons gasoline, 18,499,075 gallons diesel fuel and 2,750 gallons kerosene. Defense Fuel Supply Center, Alexandria, Va. DSA-600-69-C-0982

18—Texaco, Inc., New York, N.Y. $1,745,000. 1,000,000 barrels number six fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1397.

—Nantex-Riviera Corp., New York, N.Y. $1,451,680. 3,334,128 pairs men's white thigh length cotton drawers Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1766.

19—Marmac Industries, Inc., Marysville, Mich. $1,134,611. 704,100 helmet liners. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1774.

20—Stauffer Chemical Co., New York, N.Y. $1,075,958. 849,640 one-quart cans and 56,-980 gallons of aircraft engine lubricating oil (synthetic). Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-C-1721.

—Shell Oil Co., New York, N.Y. $1,219,771. 1,055,160 one-quart cans and 5,500 gallon of aircraft engine lubricating oil (synthetic). Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-C-1722.

—Bates Fabrics, Inc., New York, N.Y. $3,-597,462. 3,807,000 linear yards of wind resistant cotton poplin cloth, camouflage printed. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1775.

—McRae Shoe Co., Mount Gilead, N.C. $1,-132,997. 133,334 pairs of men's leather combat boots. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1571.

—J.P. Stevens and Co., Inc., New York, N.Y. $2,646,000. 1,200,000 yards polyester (fiber and wool) tropical cloth, Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1676.

—Burlington Industries, Inc., New York, N.Y. $2,507,000. 1,150,000 yards polyester (fiber and wool) tropical cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1675.

21—American Oil Co., Chicago, Ill. $1,063,705. 83,000 barrels number five and six fuel oil and 197,430 barrels diesel fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0382.

24—West Point Pepperell, Inc., New York, N.Y. $1,752,079 1,537,288 cotton bed sheets. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1790.

26—Tanenbaum Textile Co., Inc., New York, N.Y. $1,268,370 650,000 linear yards of ballistic nylon cloth Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1816

—Putnam Mills Corp., New York, N.Y. $1,-711,372 900,000 linear yards of ballistic nylon cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1817

—Emerson Clothing, Inc., Pleasantville, N.J. $1,095,513. 40,070 men's blue serge wool overcoats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1795.

—Pembroke, Inc., Egg Harbor City, N.J. $3,414,432. 100,000 men's wool gabardine overcoats with removable liners. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1829.

—Major Coat Co., Inc., Bridgeton, N.J. $2,-282,350. 65,000 men's wool gabardine overcoats with removable liners. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1830.

27—Humble Oil & Refining Co., Houston, Texas. $1,290,883. 146,000 barrels of number five fuel oil, 52,600 barrels of number six fuel oil, 231,000 barrels of Navy special fuel oil and 45,340 barrels of diesel fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1391.

—Standard Oil Co. of Calif., San Francisco, Calif $1,110,648. 49,000 barrels of number five fuel oil, 15,715 barrels number six fuel oil and 201,625 barrels diesel fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1394.

—Valley Metallurgical Processing, Inc., Essex, Conn. $2,596,860. 8,300,000 pounds aluminum powder. Defense General Supply Center, Richmond, Va. DSA 400-69-C-4304.

—U.S. Bronze Powders, Inc., Flemington, N.J. $2,718,000. 8,800,000 pounds aluminum powder. Defense General Supply Center, Richmond, Va. DSA 400-69-C-4309.

DEPARTMENT OF THE ARMY

3—Avco Corp., Stratford, Conn. $1,374,759 (contract modification). T55-L-11 turbine engines for CH-47C helicopters. DA AJ01-68-C-1853; $1,531,500. CY 1969 product improvement program for T53 turbine engines. DA AJ01-69-C-0435; $2,308,500. CY 1969 product improvement program for T55 turbine engines. DA AJ01-69-C-0436. All three contracts were awarded by the Aviation Systems Command, St. Louis, Mo.

—L. E. Mason Co., Hyde Park, Mass. $1,-395,632. Metal parts for nose body assemblies for bombs. Edgewood Arsenal, Md. DA AA15-69-C-0160.

—White Motors, Lansing, Mich. $3,517,540 (contract modification). 2½-ton trucks (M602). General Purpose Vehicles Project Manager, Warren, Mich. DA AE06-69-C-0003.

4—Rulon Co., Chicago, Ill. $7,430,500. Metal parts for point detonating fuzes for 105mm and 155mm projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0266.
—Boeing Co., Morton, Pa. $2,006114. Inspection and repair, as necessary, of nine CH47A helicopters and one CH47B helicopter, Aviation Systems Command, St. Louis, Mo. DA AJ01-69-C-2133.
5—General Motors, Cleveland, Ohio. $1,953,-851 (contract modification). Gun/turret drive improvement program for the Main Battle Tank. Cleveland, Ohio and Milwaukee, Wis. Tank Automotive Command, Warren, Mich. DA 20-113-AMC-00843 (T).
—Chrysler Motors, Warren, Mich $1,908,-197 (contract modification). One-ton cargo trucks. Tank Automotive Command, Warren, Mich. DA AE07-69-C-0771.
—Bell Aerospace Corp., Amarillo, Tex. $1,877,054. Repair of seven UH-1B and fifty-one UH1C aircraft. Aviation Systems Command, St. Louis, Mo. DA AJ01-68-C-0056.
—Western Electric, New York, N.Y. $1,688,-500 (contract modification). Systems analysis studies in connection with the Sentinel Missile System. Whippany, N.J Sentinel Systems Command, Huntsville, Ala. DA 30-069-AMC-00333 (Y).
—Philco-Ford Corp., Willow Grove, Pa. $1,-669,443 (contract modification). One year operation and maintenance at the Nha Trang Autodin site in Vietnam. Electronics Command, Fort Monmouth, N.J. DA 36-039-AMC-05589 (E).
6—Olin Mathieson Chemical Corp., East Alton, Ill. $4,192,240 (contract modification) Loading assemblies of 81mm projectiles Marion, Ill. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0086.
—Chamberlain Mfg. Corp., Scranton, Pa $1,843,824. Metal parts for 155mm projectiles. Ammunition Procurement & Supply Agency, Joliet, Ill DA AA09-69-C-0287.
—General Motors, Detroit, Mich $1,059,626 (contract modification). Advance production engineering of the total package procurement of 1¼-ton ambulances Warren, Mich. Tank Automotive Command, Warren, Mich. DA AE07-69-C-0071.
—FMC Corp., San Jose, Calif. $31,255,814 M113 vehicles. Tank Automotive Command, Warren, Mich. DA AE07-69-C-2600.
7—Marcmont Corp., Saco, Maine, $3,072,800 (contract modification). 7.62mm machine guns. Army Weapons Command, Rock Island, Ill. DA AF03-69-C-0050.
—Skyline Industries, Fort Worth, Tex. $2,-127,070 (contract modification). Demolition kits. Fort Worth, Tex. and McArthur, Ohio. Army Procurement Agency, Cincinnati, Ohio. DA AG31-69-C-0440.
—J.D. Dutton, Inc., Olympia, Wash $1,099,-000 Clearance of about 9000 timbered acres of reservoir land in Rogers and Nowata Counties, Okla. Engineer Dist., Tulsa, Okla. DA CW56-69-C-0070.
10—Kaiser Jeep Corp., Toledo, Ohio. $20,746,-076. XM809 five-ton trucks. South Bend, Ind. General Purpose Vehicle Project Manager, Warren, Mich DA AE06-69-C-0009.
—Chamberlain Mfg. Corp., Waterloo, Iowa. $1,003,659. Metal parts for 105mm smoke projectiles, M84E1. Ammunition Procurement & Supply Agency, Joliet, Ill. DA AA09-69-C-0383.
—Forsberg & Gregory, Redlands, Calif. $1,937,700. Construction of four 200-man three-story, reinforced concrete dormitories. Nellis AFB, Nev. Engineer Dist., Los Angeles, Calif. DA CA09-69-C-0140.
—Bell Helicopter Co., Fort Worth, Tex. $1,928,042. 172 rescue hoists for UH-1 helicopters. Hurst, Tex. Aviation Materiel Command, St. Louis, Mo. DA-AJ01-69-A0314.
—Thiokol Chemical Corp., Woodbine, Ga. $1,757,538. CS2-filled munitions. Edgewood, Md. Arsenal. DA-AA15-69-C0517.
—Olin Mathieson, East Alton, Ill. $1,006,-640. Loading, assembling and packing M84A1 fuzes for 81mm ...

(contract modification) Loaded grenade fuzes (M219E1). St Louis Park, Minn DA-AA09-69-C-0140. Both contracts awarded by Ammunition Procurement and Supply Agency, Joliet, Ill
—Wilkinson Manufacturing Co., Fort Calhoun, Neb $1,315,957. Metal fuze parts (PDM524A5) for 81mm high explosive shells. Chicago Procurement Agency. DA-AA09-69-C-0245.
—Smith and Wesson Div., Bango Punta Co., Springfield, Mass $1,300,255 38-caliber, 4-inch barrel revolvers Army Weapons Command, Rock Island, Ill. DA-AF03-69-C-0067.
—J.P. Cullen and Sons Corp., Janesville, Wis $1,360,800. Restoration of hardening house. Badger Army Ammunition Plant, Baraboo, Wis. Chicago Engineer District, DA-CA23-69-C-0065
17—Uniroyal, Inc., Detroit, Mich. $2,450,386 Pneumatic truck and bus tires Detroit, Mich., Los Angeles, Calif. and Chicopee Falls, Mass Tank Automotive Command, Warren, Mich DA-AE07-69-C-2788
18—Hughes Tool Co., Culver City, Calif $2,-357,334. Main rotor blades for OH-6A helicopters. Aviation Systems Command, St. Louis, Mo DA-23-204-AMC-03687.
—Varo, Inc., Garland, Tex $1,057,402 AN/PVS-2 starlight scopes Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0258.
19—Whittaker Corp., Columbus, Ohio. $3,473,-580. Metal parts for 81mm mortar fuzes Columbus and Westerville, Ohio Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0275.
—Remington Arms Co., Inc., Bridgeport, Conn. $2,764,385. 5.56mm ball cartridges Frankford Arsenal, Philadelphia, Pa DA-AA25-69-C0085.
20—Harnischfeger Corp., Milwaukee, Wis $5,865,398 Truck mounted cranes Escanaba, Mich. Mobility Equipment Command, St Louis, Mo. DA-AK01-69-C-7411.
—Beckman Construction Co., Fort Worth, Texas $2,044,083 Construction of aircraft engine shop. Tinker AFB, Okla Engineer District, Fort Worth, Texas DA-CA63-69-C-0125.
—A.D. Roe Co., Inc., Louisville, Ky. $1,565,-145. Construction of automotive instruction facility Fort Knox, Ky Engineer District, Louisville, Ky DA-CA27-69-C0027.
—Remington Arms Co., Inc., Bridgeport, Conn. $18,407,675. Load, assemble and pack small caliber ammunition Lake City Ammunition Plant, Independence, Mo. Ammunition Procurement and Supply Agency, Joliet, Ill DA-49-010-AMC-00003(A).
—Silas Mason Co., Inc., New York, N.Y. $6,494,132. Load, assemble and pack ammunition. Iowa Army Ammunition Plant, Burlington, Iowa. Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-68-C-0468.
—Federal Cartridge Corp., Minneapolis, Minn. $5,274,269. Load, assemble and pack 7.62mm and 5.56mm ball and tracer ammunition. Twin Cities Army Ammunition Plant, New Brighton, Minn. Ammunition Procurement and Supply Agency, Joliet, Ill. DA-36-038-AMC-01099(A).
—National Gypsum Co., Buffalo, N.Y. $2,-351,885. Load, assemble and pack ammunition. Kansas Army Ammunition Plant, Parsons, Kansas. Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00095 (A).
—Olin Mathieson Chemical Corp., New York, N.Y. $1,372,376. Production of propellants and related items. Badger Army Ammunition Plant, Baraboo, Wis. Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C0014
—Hercules, Inc., Wilmington, Del. $1,167,-077. Manufacture of various propellants. Sunflower Army Ammunition Plant, Lawrence, Kansas. Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00042(A).
21—Continental Motors Corp., Mobile, Ala $4,537,840. Remanufacture of model LDS-465-1A multi-fuel engine assemblies for 5-ton trucks. Tank Automotive Command, Warren, Mich. DA-AE07-69-C-2606.
—Pace Corp., Memphis, Tenn. $1,593,141. M127A1 illumination signals. Memphis, Tenn., and Camden, Ark Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0519.
—Xerox Corp., Pasadena, Calif. $1,184,050. AN/TVS-2 night vision sights. Pomona, Calif. Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C0264.

24—Hughes Aircraft Co., Culver City, Cal $3,880,941. Forward looking infrared sy tems for aircraft. Mobility Equipme R&D Center, Fort Belvoir, Va. D AK02-69-C-0433.
25—Union Carbide Corp., New York, N. $2,024,850. BA-386/PRC-25 dry batteri for radio sets Electronics Comman Philadelphia, Pa DA-AB05-69-C-34
—Motorola, Inc., Scottsdale, Ariz. $1,91 136 Fabrication of pilot line facilities f XM596 fuzes for 40mm grenade launche Harry Diamond Laboratories, Washin ton, D.C DA-AG39-69-C0041.
—General Motors Corp., Anderson, In $1,313,530. Storage batteries for gene vehicles Anaheim, Calif. Tank Autom tive Command, Warren, Mich. DA-AE 69-C-3263.
26—Texas Instruments, Inc., Dallas, Tex $4,500,000 (contract modification). Clas fied electronic equipment. Electronics Co mand, Fort Monmouth, N.J.
—Stromberg-Carlson Corp., Rochester, N. $2,384,000 (contract modification). In gration/maintenance management a technical operation services for the Sou east Asia automatic telephone syste Electronic Command, Fort Monmou N.J. DA AB-07 67 C0580.
—Western Electric Co., New York, N. $1,656,900 Improved Nike Hercules H Burlington, N C. Missile Command, R stone Arsenal, Huntsville, Ala. DA AH-68 A0041.
27—Grumman Aircraft Engineering Cor Bethpage, N Y. $10,268,556. OV-1D M hawk aircraft related test data and ports Stuart, Fla, and Bethpage, N. Aviation Systems Command, St. Lou Mo DA-AJ01-69-C-0002
—Litton Systems, Inc., Woodland Hil Calif $5,891,000 (contract modificatio AN/ASN-86 inertial navigational sy tems for OV-1D Mohawk. Electron Command, Fort Monmouth, N J. D AB07-68-C-0345.
—Chamberlain Manufacturing Corp., El hurst, Ill $4,330,712. Metal parts f 81mm projectiles. Burlington, N.J. A munition Procurement and Supply Ag cy, Joliet, Ill. DA-AA09-69-C-01
—Mine Safety Appliances, Pittsburgh, P $2,829,480 Riot control agent mas Ellport, Pa, and Export, Pa. The Ed wood Arsenal, Md DA-AA15-68-C-04
—Bell Aerospace Corp., Fort Worth, Tex $1,193,753 UH-1 series helicopter sp gears. Hurst, Texas. Aviation Syste Command, St Louis, Mo. DA-AJ01-6 A0314
28—Sperry Rand Corp., New York, N.Y. $2 079,830 (contract modification). Load, semble and pack ammunition, and support services Shreveport, La. A munition Procurement and Supply Ag cy, Joliet, Ill. DA-11-173-AM 00080(A).
—Bulova Watch Co, Providence, R.I. $ 576,000. Head assemblies for 60mm pr jectile fuzes. Ammunition Procureme and Supply Agency, Joliet, Ill. DA-AA 69-C-0721.
—Chamberlain Manufacturing Corp., El hurst, Ill. $1,509,470 (contract modific tion). Repairs and facilities in support 8-inch and 175mm projectile metal par Scranton, Pa. Ammunition Procureme and Supply Agency, Joliet, Ill. DA-3 034-AMC-0163(A).
—Union Carbide Corp., New York, N. $3,024,420. Dry batteries and high te perature testing Greenville, N.C., a Cleveland, Ohio. Electronics Comman Philadelphia, Pa DA-AB05-69-C-34
—General Motors Corp., Cleveland, Oh $2,346,852 Spare parts for M551 tan Procurement Agency, Cincinnati, Oh DA-AG31-69-C-0388.
—Gould National Battery, Inc., St. Pa Minn. $2,178,460. Dry batteries and hi temperature testing. Electronics Co mand, Philadelphia, Pa. DA-AB05-6 C-3469.
—Cannon Construction Corp., Beverly Hi Calif. $2,169,000. Construction of fam housing units. Presidio, San Francis Calif Engineer District, Sacrament Calif. DA-CA05-69-C-0087.
—Continental Motors Corp., Muskego Mich. $2,009,206 (contract modification Spare diesel engines for M60 and M tanks. Tanks Automotive Comman Warren, Mich. DA-AE07-68-C-27
—Olin Mathieson Chemical Corp., Ea Alton, Ill. $1,172,038. Fuel assembly bloc for AN/M7 smoke pots. Marion, I

Arsenal, Md. DA-AA15-69-

ors Corp., Cleveland, Ohio
d $1,404,000 (contract modi-
5mm self propelled howitzers
nmand, Rock Island Arsenal,
9-AMC-00610(W).

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amics, Pomona, Calif. $6,095,-
t modification) Increase in
n of authorization for Stand-
nissiles. Naval Air Systems
00019-68-C-0074.
Inc., West Covina, Calif. $2,-
aining device 14A2D. Navy
evice Center, Orlando, Fla.
-0036.
Co., Portland, Maine, $1,420,-
Airfield for Tactical Support
resting gear systems (M21)
equipment. Naval Air Engi-
er, Philadelphia, Pa. N00156-

Construction, San Diego,
,137. Construction of Aircraft
ng Stations at the Naval Air
Iramar, San Diego, Calif.
Div. Naval Facilities Engi-
mmand, San Diego, Calif.
-3012.
uilders, Sturgeon Bay, Wis.
Construction of six large
r tugs (YTB) Naval Ship
ommand. N00024-69-C-0280.
ectric, New York, N.Y. $1,-
tract modification). Manufac-
electronic signal processing
set. Burlington, N.C. Naval
Systems Command. N00039-

uments, Dallas, Tex. $1,721,-
le detecting sets. Naval Air
ommand N00019-69-C-0412.
ral Precision, Inc., Glendale,
,000. Development of torpedo
ire control. Naval Ordnance
Command. N00017-69-C-1212.
d Corp., Great Neck, N.Y.
Modifications for Terrier MK
3 & 5, Fire control System
m (production). Naval Ord-
ms Command. N00017-67-C-

ectronics Corp., Macon, Ga.
MK 31, MOD 2, base detona-
for 5" 54 caliber projectiles.
Parts Control Center, Mech-
Pa. N00104-69-C-0299.
e Electric, Baltimore, Md.
Components of APD-7 side
ar systems for installation in
raft, Aviation Supply Office,
, Pa. N00383-69-A-4000-

ectric, West Lynn, Mass. $5,-
Development of TF34-GE-2
l flight test engines for the
test program Naval Air Sys-
and. N00019-69-C-0424.
Electronics, Anaheim, Calif.
Poseidon missile test instru-
Strategic Systems Project
30-69-C-0209.
Construction Co., Cambridge,
0,375. Construction of BOQ
l Station, Newport, R.I. North-
Naval Facilities Engineering
Boston, Mass. N62464-69-C-

, Silver Spring, Md., $9,784,-
ering services and support for
sile systems. Naval Ordnance
Command. N00017-69-C-4415.
struction Co., San Diego, Calif.
Construction of barracks and
all. Camp Pendleton, Calif.
Div., Naval Facilities Engi-
ommand, San Diego, Calif.
C-0179.

—United Aircraft, Hartford, Conn $4,500,000. Conversion kits for converting TF-30-P-8 engines to TF-30-P-400 configuration. Aviation Supply Office, Philadelphia, Pa. N00383-9-6900A-AG242.

—Sperry Rand Corp., St. Paul, Minn. $2,510,000. Furnishing tactical data system design and programming services, and for technical documentation and reports Naval Ship Systems Command. N00024-69-C-1218.

—Sparton Corp., Jackson, Mich $1,229,937 AN/SSQ-53 sonobuoys. Naval Air Systems Command. N00019-69-C-0165

12—Westinghouse Electric Corp., Baltimore, Md $2,717,491 (contract modification) AN/APG-59, 60 and 61 radar sets and associated equipment Naval Air Systems Command NOw 66-0138.

—General Dynamics Corp., Pomona, Calif $2,076,128. Work on Terrier/Tartar missiles Naval Ordnance Systems Command. N00017-68-C-2108.

—General Electric Co., Utica, N.Y. $1,801,098 (contract modification) Guidance and control groups for Chaparral missiles. Naval Air Systems Command N00019-68-C-0322

—Lockheed Aircraft Corp., Watchung, N.J. $1,817,659. Antiaircraft modification kits for gun fire control systems (MK 86 Mod 0) Naval Ordnance Systems Command. N00017-67-C-2308.

13—Hughes Aircraft Co., Fullerton, Calif. $1,145,886. AN/SPS-32 radar modification kits Naval Ships Systems Command. N000024-69-C-1201.

14—United Aircraft Corporation, Hartford, Conn $7,431,957 (contract modification). J52-P-8A engines N00019-67-C-0182.; $4,776,063. Design and development of TF-30-P-100 engine. N00019-69-C-0366. Both contracts by Naval Air Systems Command.

17—LTV Aerospace Corp., Dallas, Tex. $1,667,874 (contract modification) Improvement changes on RF-8A aircraft Naval Air Systems Command. N00019-68-C-0130.

18—Raytheon Co., Portsmouth, R.I. $3,592,293. Submarine sonar equipment. Naval Ship Systems Command. N00024-69-C-1261.

—Magnavox Co., Fort Wayne, Ind. $2,175,000. Classified work Naval Electronics Systems Command. N00039-69-C-1560.

—Raytheon Co., Lexington, Mass. $1,255,000. Research and development on AN/SPG-51 radar and fire control systems for Tartar missile. Wayland, Mass. Naval Ordnance Systems Command. N00017-69-C-2318.

19—Peterson Builders, Inc., Sturgeon Bay, Wis. $2,166,060. Construction of five motor patrol gunboats (PGM). Naval Ship Systems Command. N00024-69-C-0288.

—Sperry Rand Corp., St. Paul, Minn. $1,279,510 Computer components, spare parts and engineering services. Naval Ship Systems Command. N00024-69-C-1211

—Aerojet General Corp., Sacramento, Calif. $1,179,000 Sparrow missile rocket motors. Naval Air Systems Command. N00019-69-C-0222

—Dayton T. Brown, Inc., Bohemia, Long Island, N.Y. $1,163,600 (contract modification). Preproduction and production lot sample testing of bomb racks. Naval Air Systems Command N00019-68-C-0324.

20—United Aircraft Corp., East Hartford, Conn. $6,500,000. Design, development and testing of TF30-P-401 engine for F14A. Naval Air Systems Command. N00019-69-C-0393

—Boeing Co., Morton, Pa. $32,009,703 (contract modification). Structural modification to CH-46 helicopter landing gear and tail sections. Naval Air Systems Command N00019-67-C-0255.

—Akwa-Downey Construction Co., Milwaukee, Wis. $1,630,922. Construction of recruit barracks, Naval Training Center, Orlando, Fla. Naval Facilities Engineering Command, through the Southeast Division, San Diego, Calif. N62473-67-C-0575.

—DeWeese Construction Co., Covina, Calif. $1,398,488. Construction of first increment of recruit school at Naval Training Center, San Diego, Calif. Naval Facilities Engineering Command through Southeast Div., San Diego, Calif. N62473-68-C-0105.

21—General Electric Co., Schenectady, N.Y. $17,673,000. Design and furnishing of nuclear propulsion components Naval Ship Systems Command. N00024-67-C-5056.

—Marine Terminals Corp., Long Beach, Calif $2,803,386 Stevadoring service. Naval Construction Battalion Center, Port Hueneme, Calif. Naval Purchasing Office, Los Angeles, Calif. N00123-69-D-0228.

24—LTV Aerospace Corp., Dallas, Texas. $28,161,681 (contract modification). Incorporation of improvement changes on F-8B and F-8C aircraft. Naval Air Systems Command. N00019-68-C-0191.

—Raytheon Co., Lexington, Mass. $2,713,918 (contract modification). Sparrow III missile guidance and control groups. Lowell, Mass., Bristol, Tenn., Bedford Mass and Oxnard, Calif. Naval Air Systems Command. N00019-68-C-0225

—La Pointe Industries, Inc., Rockville, Conn $1,176,500 AN/URC-32 radio sets and MK447/URC-32 kits. Naval Electronic Systems Command. N00039-69-C-0546

—Jacksonville Shipyards, Inc., Jacksonville, Fla $1,166,131. Overhaul and improvement of crew quarters on USNS Twin Falls. Military Sea Transportation Service, Atlantic. N00033-66-C-0020.

25—LTV Aerospace Corp., Dallas, Texas. $2,808,076 (contract modification). Incorporation of improvement changes on RF-8A aircraft. Naval Air Systems Command. N00019-68-C-0130.

—United Aircraft Corp., East Hartford, Conn. $2,381,022 Spare parts for TS-30P8 and J52P8A/P6A engines. Aviation Supply Office, Philadelphia, Pa. N00383-9-69000A-AG252

—North American Rockwell Corp., Anaheim, Calif. $1,529,663. Design, manufacture and acceptance testing, plus documentation and field services, for Search Set Sub-Systems of the Target Designator System Naval Purchasing Office, Los Angeles, Calif N00123-69-C-0507.

27—Austin-Wright Construction Co., Oklahoma City, Okla. $1,375,000. Rehabilitation of Bachelor Officers' Quarters and Mess, Marine Corps Air Station, Cherry Point, N.C. Naval Facilities Engineering Command, through Atlantic Division, Norfolk, Va. N62470-68-C-0049.

—Liles Construction Co., Inc., Montgomery, Ala. $1,158,963. Alterations to family housing units, Naval Station, Key West, Fla. Naval Facilities Engineering Command, through Southeast Division, Charleston, S.C. N62467-67-C-0186.

—Remcor Inc., Williamstown, N.J. $1,074,600. Heads for 5-inch spin-stabilized rockets. Ships Parts Control Center, Mechanicsburg, Pa N00104-69-C-0307.

28—Collins Radio Corp., Cedar Rapids, Iowa. $3,201,632. Buoy sub-systems, test sets and support services for Project SECT. Naval Ordnance Laboratory, White Oak, Md. N60921-69-C-0121.

—Sparton Corp., Jackson, Mich. $3,137,800. AN/SSQ-41A sonobuoys. Naval Air Systems Command. N00019-69-C-0495.

—Bendix Corp., Mishawaka, Ind. $1,325,000. Talos missile UHF telemetering and field conversion rework kits. Naval Ordnance Systems Command. N00017-69-C-0405.

—Sanders Associates, Inc., Nashua, N.H. $1,223,606. Development and operation of special radar simulation facilities for test and evaluation of ECM systems. Naval Air Systems Command. N00019-69-C-0329.

—United Aircraft Corp., Norwalk, Conn. $1,881,289. Components for radar systems in A-6A and EA-6A aircraft. Navy Aviation Supply Office, Philadelphia, Pa. N00383-67-A5506-0461.

—Hughes Aircraft Co., Fullerton, Calif. $2,625,000. Modernization of AN/SPS-38 radar equipment. Naval Ship Systems Command. N00024-69-C-1244.

—General Electric Co., Washington, D.C. $1,189,000. Nuclear machinery propulsion components. Fitchburg, Mass. Naval Ship Systems Command. N00024-69-C-5417.

—Sperry Rand Corp., St. Paul, Minn. $1,189,310. Design, development and fabrication of pre-production model computer component for Naval Tactical Data System. Naval Ships System Command. N00024-69-C-1245.

DEPARTMENT OF THE AIR FORCE

3—**Litton Systems**, Woodland Hills, Calif. $2,199,900. Gyroscope component of the inertial navigation system for F-4 aircraft. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F04606-68-A-0147.

—**TRW, Inc.**, Redondo Beach, Calif. $14,000,000. Design of satellites and dispensers. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif.

4—**Olin Mathieson Chemical Corp.**, East Alton, Ill $1,111,264 Production of engine starter cartridges applicable to B-57 aircraft. Marion, Ill. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah F42600-69-C-2571.

5—**Hunt Building Marts**, El Paso, Tex $4,469,640. Construction of 300 family housing units at Holloman AFB, N M Holloman AFB, N M. F29651-69-C-0265.

—**Bendix Corp.**, Teterboro, N.J. $1,600,000. Procurement of components applicable to modification of B-52 aircraft Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F09603-69-A-0088.

—**Sargent Fletcher Co.**, El Monte, Calif $1,501,402 (contract modification). Production of external fuel tanks for F-5 aircraft. Aeronautical Systems. Div., (AFSC), Wright-Patterson AFB, Ohio F33657-67-C-1339-P006.

—**Melpar, Inc.**, Falls Church, Va. $1,002,970. Modification kits for ground communication equipment. Oklahoma City Air Materiel Area, (AFLC), Okla. F09603-68-A02-62-SD02.

6—**Ets-Hokin & Galvan Corp.**, San Diego, Calif. $1,606,158. Design and fabrication of a bare base electrical distribution system. Aeronautical Systems Div, (AFSC). Wright-Patterson AFB, Ohio. F33657-69-C-0784.

7—**General Electric**, Cincinnati, Ohio. $51,841,600. Production of J-79 turbojet engines for F-4E aircraft. Evendale, Ohio. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio F33657-68-C-1232-P002.

—**FWD Corp.**, Clintonville, Wis. $4,114,653. Production of 24 fire fighting trucks. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-69-C-0074.

10—**General Motors**, Goleta, Calif. $1,225,000. Research in hypervelocity speed range. Space & Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0125 PZ01.

—**Burroughs Corp.**, Paoli, Pa. $1,060,589. Production of modification kits for teletype equipment. Electronic Systems Div., (AFSC), L. G. Hanscom Field, Mass. F19628-69-C-0224.

12—**Pioneer Parachute Co.**, Manchester, Conn. $1,294,820. Production of drag parachute assemblies for mid-air retrieval systems. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-C-0568.

—**North American Rockwell Corp.**, Columbus, Ohio. $7,000,000. Guided bomb kits, spare parts and aerospace ground equipment and data. Aeronautical Systems Division (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0400.

13—**Goodyear Aerospace Corp.**, Akron, Ohio. $2,994,650. Design, fabrication and testing of personnel shelters. Aeronautical Systems Division, (AFSC). F33657-69-C-0773.

14—**United Aircraft Corp.**, Hartford, Conn. $1,082,873. Component parts for J-57 aircraft engines. San Antonio Air Materiel Area (AFLC), Kelly AFB, Tex. N883-6900A SA 69-1221.

—**Oshkosh Truck Corp.**, Oshkosh, Wis. $1,692,445 112 snow removal vehicles Warner Robins Air Materiel Area (AFLC), Robins AFB, Ga. F09603-69-D-0002-0002.

—**Cullman Metalcraft Inc.**, Cullman, Ala. $3,397,244. Production of bomb components Armament Development and Test Center, (AFSC), Eglin AFB, Fla. F08635-69-C-0032.

—**Camden Mfg. Co. Division of Batesville Mfg. Co.** Camden, Ark. $3,456,000 Bomb components. Armament Development and test Center, (AFSC). F08635-69-C-0033.

—**Litton Industries, Inc.**, San Carlos, Calif. $1,056,000. Production of electron tubes Warner Robins AMA, (AFLC) F09603-69-C-3176.

—**Hensel-Phelps Construction Co.**, and Hensel-Tointon Constructors, Inc., Greeley, Col $1,879,000 Construction of munitions handling and storage building Grand Forks AFB, N.D Army Corps of Engineer Ballistic Missile Construction Office, Los Angeles, Calif. DACA 13-69-C-0005

17—**IBM**, Washington, D.C $1 768,402. Special test equipment for Minuteman III guidance and control systems San Jose, Calif Space and Missile Systems Organization, Los Angeles, Calif. F04701-69-C-0130.

19—**Honeywell, Inc.**, St Petersburg, Fla. $5,200,000 Production of electronic equipment applicable to Minuteman. Space and Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-63-C-0187

—**REDM Corp.**, Wayne, N J. $1,662,873 Production of components for general purpose bombs Ogden Air Materiel Area, (AFLC), Hill AFB, Utah F42600-69-C-2986

—**Continental Aviation and Engineering Corp.**, Detroit, Mich $1,011,574. Field service tests and maintenance support for J-69 series engines. Aeronautical Systems Division (AFSC) Wright-Patterson AFB, Ohio. F33657-69-C-0449

20—**United Technology Center**, Sunnyvale, Calif. Definization of previously awarded letter contract. $46,035,000 previously awarded (no money awarded on this date). Development of seven-segment solid rocket motors for Titan IIIM Manned Orbiting Laboratory (MOL) launch vehicles. Manned Orbiting Laboratory, Systems Office, (AFSC), Los Angeles, Calif. AF 04/695/-1022.

21—**McDonnell Douglas Corp.**, St. Louis, Mo. $1,651,600. Modification of F-4C aircraft. Robertson, Mo. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F34601-68-A-2919.

24—**Continental Aviation and Engineering Corp.**, Detroit, Mich. $2,000,000. YJ-69-T-400 engines Aeronautical Systems Division (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0828.

27—**IBM Corp.**, Owego, N.Y. $7,000,000. Manufacture of components for improved B-52 bomb navigational system. Warner Robins Air Materiel Area (AFLC), Robins AFB, Ga F09603-69-C-3096.

—**TRW, Inc.**, Redondo Beach, Calif. $2,102,400 Minuteman operational targeting verification and validation program. Space and Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0121.

—**Itek Corp.**, Palo Alto, Calif. $1,289,000. Radar homing and warning systems for various aircraft. Sunnyvale, Calif. Warner Robins Air Materiel Area (AFLC), Robins AFB, Ga. F04606-69-A-0141.

28—**Avco Corp.**, Stratford, Conn. $5,367,590. Production of ballistic missile penetration aids Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0089.

—**Boeing Co.**, Wichita, Kansas. $7,200,000. Development of electrical optical viewing system for B-52. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-2437.

—**Goodyear Tire and Rubber Co.**, Akron, Ohio. $1,200,069. Production of collapsible fuel tanks with 50,000 gallon capacity. Litchfield Park, Ariz. San Antonio Air Materiel Area. AFLC, Kelly AFB, Texas. F41608-69-C-8186.

Army Studies New Cargo Air-Drop System

A parawing system for silent and accurate air-drop of supplies, from as far as 12 miles away and 30,000 feet above the drop zone, is being studied by mobility planners of the U. S. Army Combat Developments Command (CDC), Fort Belvoir, Va.

Under consideration for Army-wide adoption, the parawing can be deployed from current military cargo aircraft. It is designed to operate when combat conditions require military aircraft to keep well out of enemy sight and hearing. This delivery method may be used also where terrain makes conventional air-drop procedures difficult. After ejection from aircraft, a radio control unit guides the parawing and payload to "home in" to a selected impact point on the ground. If required, the flight path can be changed during descent by an operator on the ground.

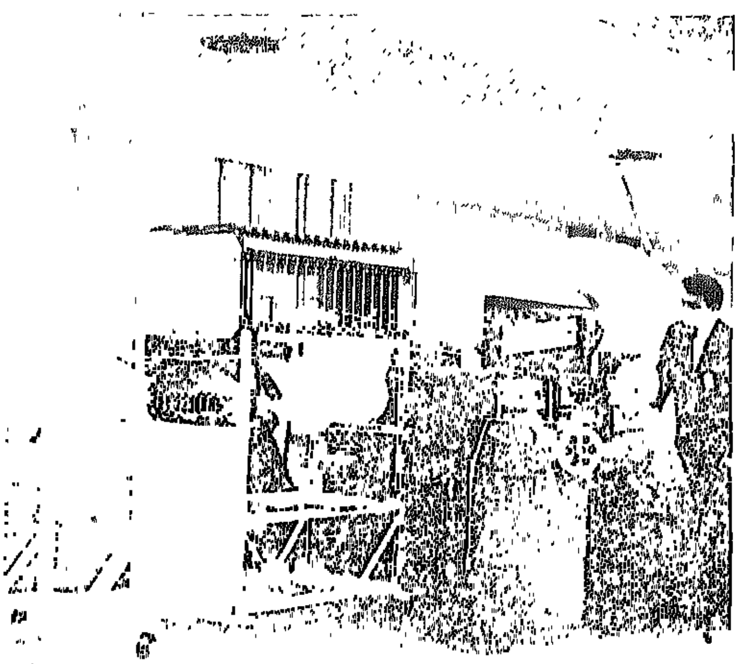
Fifteen of the steerable gliders have been produced for the Army Aviation Materiel Laboratories, Fort Eustis, Va. Mobility experts have identified the user's requirements, performance characteristics, and are closely monitoring development of the controlled air-drop system.

The system's radio control unit was developed by Ryan Aeronautical Co. Goodyear Aerospace developed the parawing which is now undergoing engineer testing.

Cooling Unit Type Classified for Production

An 18,000 BTU/Hr trailer mounted air conditioner, designed to cool complex mobile electronic systems in combat conditions, has been type classified by the Army for limited production.

Developed by the U. S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., it employs such Military Standard items as the 18,000 BTU/H multi-pack air conditioner and the KW gasoline engine driven generator mounted on a ¾-ton trailer. The air conditioner uses Refrigerant-12 as coolant.



ıtrolled louvres direct air into and out of test section of experi- tunnel at Arnold Engineering Development Center.

Tries as in Wind Tunnel

orce Systems Command's gineering Development ahoma, Tenn., is conduct- that may lead to signifi- ements in wind tunnels ertical and short takeoff V/STOL) aircraft.

wind tunnel design con- ian blind-like louvres conventional smooth or alls in the test section. are controlled by a com- manipulates them to ir through the test sec- an air flow pattern like ift engines of a V/STOL

lid and perforated wall downwash from the lift flected from the walls to recluding valid simulation ght environments. Work d at determining if the matching" is accurate warrant incorporation of o operational wind tun-

nt of the louvred-wall directed after a compu- alysis of the complex air- ted by V/STOL craft.

Navy Tests New Lightweight 5-Inch Gun

The Navy has successfully completed initial shipboard tests of the lightest mid-caliber automatic gun ever constructed by the United States.

The gun, to be installed on most of the Navy's new warships, is being evaluated on the ordnance test ship USS Norton Sound. Known as the Mark 45, the new rapid-fire 5-inch 54-caliber weapon reflects the Navy's renewed emphasis on improved conventional ordnance to meet present and future needs.

Under development since 1964, the Mark 45 weighs only one-third as much as present 5-inch 54-caliber guns and needs of a crew of only 6 men, compared to the 16 currently required.

The gun's unusual lightness—less than 50,000 pounds—stems from simplicity of design in the gun mount's silhouette and operating parts, and the use of aluminum and special lightweight steel in the gun's construction.

A unique feature of the Mark 45 is that the gun crew need not enter the gun mount. The gun can be loaded, controlled and fired from remote positions below decks.

Developed by the Navy's Ordnance System Command, the Mark 45's automated characteristics reflect the presence of numerous solid state circuits. A remote control light panel provides a continuous display of the status of the gun's various components.

Performance of the Mark 45 has exceeded expectations throughout the gun's development. Firing tests to date have demonstrated a high degree of accuracy and reliability.

The Mark 45 can fire 20 projectiles per minute at air and surface targets more than 10 miles away. The gun was designed to accommodate all existing types of 5-inch 54-caliber ammunition, as well as the long-range rocket-assisted projectiles just developed by the Navy.

Delivery of the guns to the Fleet will begin next year or early 1971.

F-15 Logistic Management to Warner-Robins AMA

Responsibility for logistic management of the new F-15 advanced tactical fighter has been assigned to the Air Force Logistics Command's Warner Robins Air Material Area, Robins AFB, Ga. The assignment will include item management and specialized repair activity.

Immediate impact of the assignment is not expected to be great, but it is being made at this time to assure that all support functions are exploited during the design and development phases of the aircraft's systems.

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Air Force Works on Miniature Pilot TV Target Display

A combination of a remotely controlled TV camera and display screen, which will allow a pilot to more easily detect and strike targets on the ground, is being developed in a joint Air Force-Navy program.

Development of the electro-optical device, called an airborne helmet-mounted display, is being managed by the Air Force Systems Command's Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio.

The display screen, coupled to a television camera mounted on the aircraft, will enable the pilot to see beyond aircraft structures that otherwise obscure his vision. Electronic sensors, developed by Honeywell, Inc., Minneapolis, Minn., are built into the side of the helmet to move the camera in the same direction the pilot is looking.

The helmet-mounted display projects a half-dollar size viewing screen 18 inches in front of the pilot's right or left eye, depending on which side of the helmet the display is mounted. The screen image is then magnified through optics in the device.

The pilot is not required to adjust his vision between the cockpit display and the outside world, because he sees the image at the same depth of field as if he were looking outside the aircraft.

The display also shows air speed, altitude and other information, making it unnecessary for the pilot to take his eyes off target to check the instruments. The large screen display permits the image to be presented at a scale which aids target identification, location and acquisition. It also prevents interference from bright sunlight and is designed to "see" even when the pilot cannot.

Built by Hughes Aircraft Co., Culver City, Calif., the one-pound display consists of a one-inch cathode ray tube, projection optics and connecting electrical cables. The unit can be detached by the pilot in case of emergency.

Initial tests are being conducted by the Aerospace Medical Research Laboratories.

AF Logistics Command Realigns Jet Engine Management

The Air Force Logistic Command is realigning jet engine management responsibilities between two of its air materiel areas.

The shift is between Oklahoma City Air Materiel Area (OCAMA), Tinker AFB, Okla., and San Antonio Air Materiel Area (SAAMA), Kelly AFB Tex.

The switch was made, according to the Air Force Logistics Command, to be more responsive to customer requirements and to obtain better control by joining management and repair activity under the same area commander.

Under the shift J–75, J–57 and TF–33 engine management will be transferred from SAAMA to OCAMA. Responsibility for the T–56, J–85 and gas turbine engines will go from OCAMA to SAAMA.

These engines power most of the Air Force's first line aircraft. The gas turbines are used primarily as ground power units and auxiliary aircraft engines.

The transfer is to be completed by June 30, 1969.

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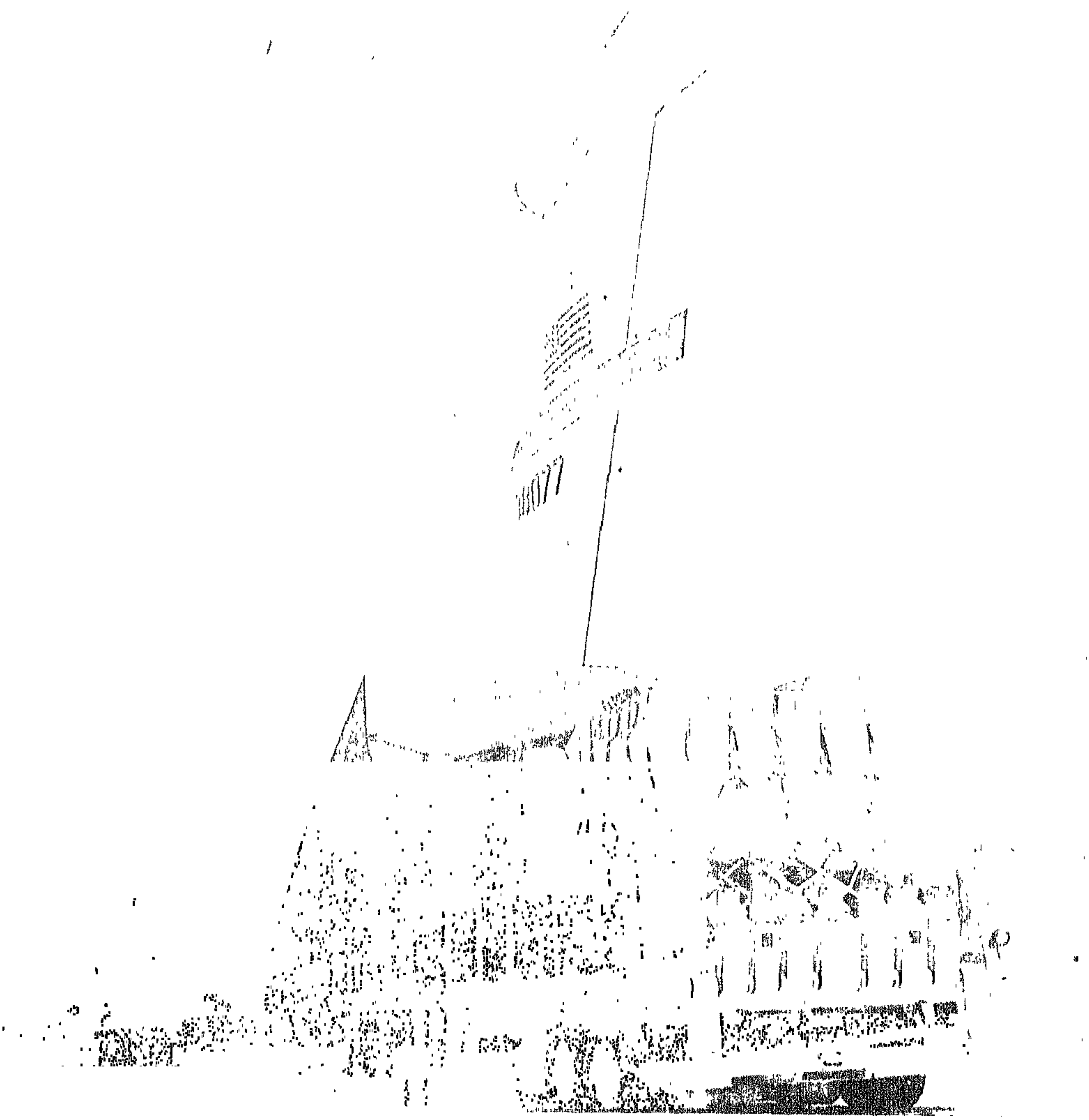
June 1969



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Suggestions from industry representatives concerning possible topics for future issues are welcomed and should be forwarded to the Editor at the address shown below.

The *Bulletin* is distributed free of charge to qualified representatives of industry and of the Departments of Defense, Army, Navy, and Air Force. Subscription requests should be submitted on company letterhead stationery, must indicate the position title of the requestor and be addressed to the Editor, Defense Industry Bulletin, OASD (PA), Pentagon, Washington, D. C. 20301.

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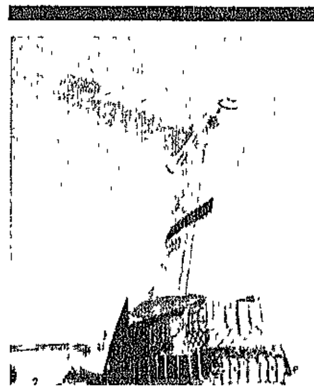
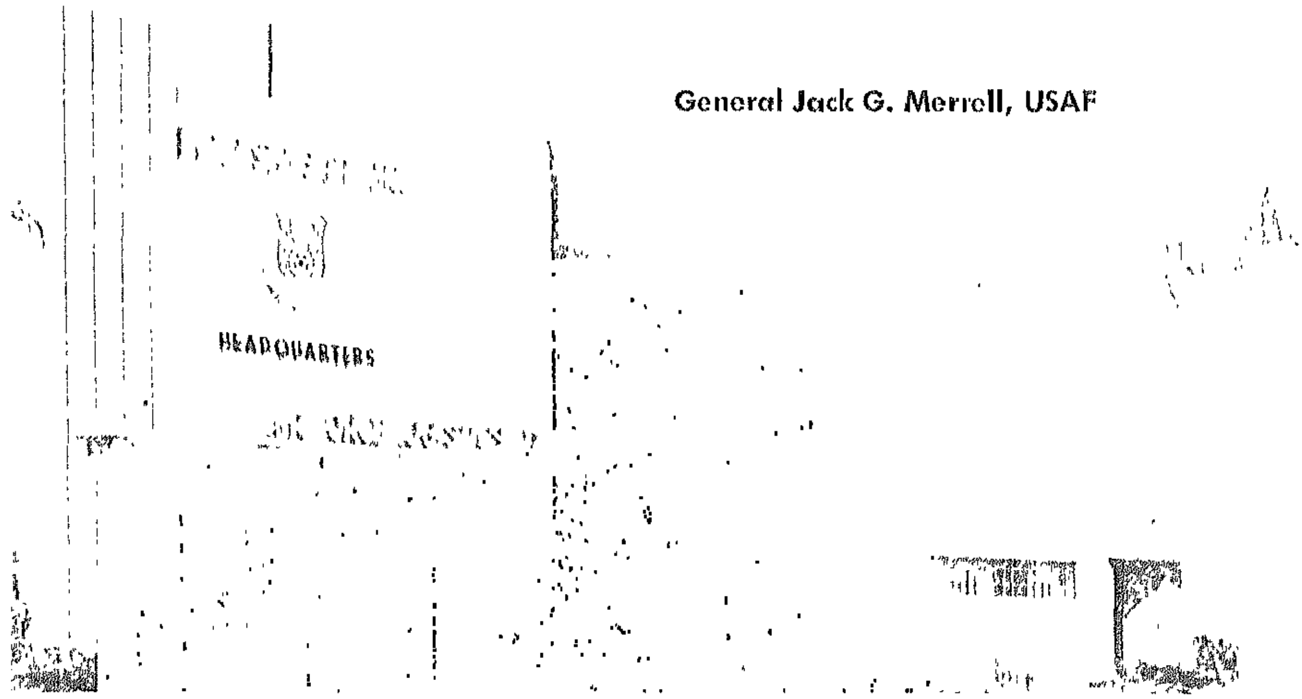


Materiel movement [illegible] jet age on a practical [illegible] the advent of the [illegible] freighter shown on this [illegible] cover. World-wide [illegible] materiel is just one of the [illegible] tions of the Air Force [illegible] Command, whose [illegible] featured in this issue.

Effective Logistic Support—Key to Air Force Operational Readiness



General Jack G. Merrell, USAF

Keeping the Air Force's weapon systems at constant readiness anywhere in the world is the mission of the Air Force Logistics Command (AFLC). This mission which is constantly growing in size and complexity must be accomplished at the lowest possible cost to the taxpayer. In carrying out its responsibility, AFLC works closely with the Air Force operational commands to assure they have the logistics needed to keep their aircraft, missiles and support equipment constantly at top efficiency.

The four main activities of AFLC are procurement, supply, depot maintenance and transportation:

- Procurement is the portion of the logistics process concerned with buying spare items, spare parts, aerospace ground equipment and related items, including requirements for maintenance, modification and technical services.
- Supply is the nucleus of logistics. Supply management techniques are tailored to fit the nature of groups of items in the Air Force inventory. An important supply function is the cataloging of some 1.7 million items used by the Air Force. Determining the quantity of items required to support the Air Force also is a supply function. This determining of needs, or computing Air Force requirements, has often been called the "heart of logistics."
- Maintenance accounts for the work of 100,000 persons, about half of whom are offbase contract personnel, who see to it that equipment performs its intended function. Information is constantly collected to improve operations and reduce costs. The basic philosophy is to minimize the need for maintenance through improved reliability, and to provide top performance at the least cost.
- Transportation is responsible for world-wide movement of Air Force material. This includes storage, warehousing, preservation and packaging of Air Force property, management of materials handling equipment, and operation of the Logistics Airlift System (LOGAIR) which provides airlift support to Air Force bases in the continental United States.

Organization and Operation Functions

Command headquarters of AFLC is located at Wright-Patterson AFB, Ohio. The big industrial-type logistics centers which carry out most of the command's operational functions are known as air materiel areas (AMAs). There are five of them all in the United States.

Before the late 1950s, AFLC depended on its U.S.-based installations and a selected number of overseas depots to provide support to widely deployed Air Force units. This required lengthy pipelines, stretching from manufacturers through AFLC's stateside installations to the overseas depots and, finally, to the operational units.

Within the last decade AFLC has refined its logistics concept as well as its operations. The Air Force today is geared for instant retaliation. It must be prepared to strike decisive blows with what is already on hand if hostilities begin. The logistics concept today is direct support. The day of costly stockpiling in vulnerable

overseas depots has ended. Direct support means high-speed movement from the United States of priority and high-value materials. It requires almost instantaneous communications and electronic data processing. Today an Air Force activity requisitions and receives directly from AFLC's AMAs whatever Air Force items it needs, regardless of its location in the world.

Every weapon system in the Air Force inventory—and there are more than 300 types—has a "home" AMA. Each AMA has responsibility for the world-wide logistics management of the weapon systems assigned to it for which it provides a system manager. San Antonio AMA in Texas, for example, provides the system manager for the giant C-5A transport. This means that whenever the C-5A will need a replacement part—no matter in what part of the world—the organizational unit will call upon San Antonio and get immediate service by cargo aircraft delivery. If in need of major repair or overhaul, the C-5A will be flown to San Antonio's maintenance shops. Ogden AMA in Utah has the same responsibilities for the Minuteman missile, while Warner Robins AMA in Georgia is the logistics home for the C-141 and many other cargo aircraft.

The key operational activities in the AFLC organizational structure and their responsibilities are:

- Oklahoma City AMA (OCAMA), Tinker AFB, Okla., manages repairs and furnishes spare parts for the B-52, B-47, C/KC-135 and certain other aircraft, as well as a number of aircraft engines and airborne missiles. OCAMA also provides a system manager for a number of ground communications-electronics systems.

- Ogden AMA (OOAMA), Hill AFB, Utah, takes logistics care of the Titan II, Titan III, and the solid-fueled Minuteman missiles. It performs logistic management of the versatile F-4 aircraft and the F-101 Voodoo supersonic fighter. Ogden AMA also manages the logistics of the Air Force air munitions program.

- San Antonio AMA (SAAMA), Kelly AFB, Tex., manages 63 percent of the Air Force's total engine inventory, comprising nearly 40,000 separate engines. Its aircraft responsibilities include the F-102 and F-106 fighter-interceptors, the supersonic B-58 Hustler bomber, and the C-5A, now in the flight-test stage. SAAMA also manages logistic support of Air Force reentry vehicles.

- Sacramento AMA (SMAMA), McClellan AFB, Calif., manages the logistics support for all Air Force satellites and satellite tracking systems. In addition, it is responsible for the new F-111A variable-sweep wing fighter, as well as the F-100, F-104, F-105, F-84, F-86, T-28, A-1, T-6 and EC-121 aircraft, and is also the repair activity on the F-106 fighter-interceptor. The Air Force's ground power generator program is SMAMA's responsibility, as is systems support for SAGE and BMEWS equipment.

- Warner Robins AMA (WRAMA), Robins AFB, Ga., has responsibility for logistics management of most of the Air Force's transport aircraft. Included are the C-140 and C-141 jet transports, C-130 and C-133 turboprop transports, and the C-46, C/AC-47, C-118, C-119, C-123 and C-124. WRAMA has similar responsibilities for the B-57, B-66, eight types of utility aircraft, 13 types of helicopters, and the X-142 and X-19 experimental VTOL aircraft, as well as the Mace missile and the Firebee target drone. Other responsibilities include bomb, navigation and fire control systems, airborne communications equipment, vehicles and components, and a number of other equipment classes.

- The Ground Electronics Engineering Installation Agency (GEEIA), headquartered at Griffiss AFB, N.Y., provides single-point management for the engineering, installation and maintenance of Air Force ground communication-electronic equipment, including radio, radar, teletype and telephone systems. About 12,000 people, mostly military, make up 14 squadrons operating in five regions located throughout the world.

- The Aerospace Guidance and Metrology Center (AGMC), located at Newark AFS, Ohio, is the single point within the Air Force for the repair and calibration of inertial guidance systems. The center provides direct support to the Minuteman and Titan missile systems. The navigational system support for the F-4 aircraft is also provided by AGMC.

- The DOD Military Aircraft Storage and Disposition Center, Davis-Monthan AFB, Ariz., is under the executive direction of AFLC. The center stores, reclaims and redistributes inactive aircraft for all three Military Services.

- The Advanced Logistics Systems Center (ALSC), Wright-Patterson AFB, Ohio, is charged with developing a "21st Century Logistics System," and implementing it in the early 1970s. Using third generation computers, advanced communications, and new techniques in the management sciences, ALSC is expected to produce new concepts and procedures in Air Force logistics.

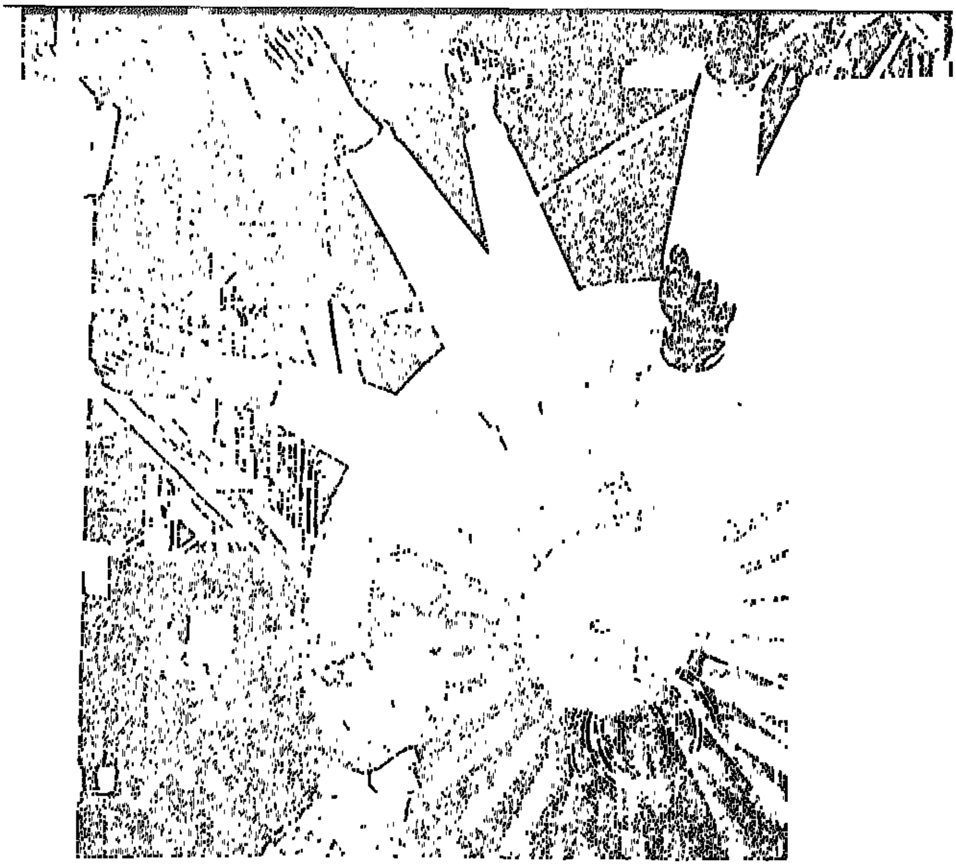
- Air Procurement Region, European (APRE) and Air Procurement Region, Far East (APRFE) are overseas extensions of AFLC to accomplish offshore logistics procurement in their respective areas. They are primarily concerned with modification/inspection and repair as necessary (IRAN) procurements, as well as contractor crash and battle damage repairs in the overseas theaters.

In addition to the foregoing organizations, AFLC is in the process of establishing a new organization to be known as the Air Force Contract Maintenance Center. The center

General Jack G. Merrell, USAF, is Commander of the Air Force Logistics Command, with responsibility for keeping Air Force weapon systems operationally ready. Prior to assuming this command, General Merrell was the Comptroller of the Air Force, and before that served as Director of Budget in Headquarters, U. S. Air Force. He is a graduate of the U. S. Military Academy, class of 1939.

will be responsible for administration of contracts at industrial plants located primarily in the southeastern United States. The Defense Department assigned contract management responsibility for these plants to AFLC because of the predominance of Air Force contracts in that area resulting from logistic support needs. Government contracts in the facilities include depot-type maintenance on Special Air Mission (SAM) aircraft, as well as modification and overhaul work on about one-fourth of the first-line fighter and cargo aircraft in the Air Force operational inventory.

Headquarters for the center will be located at Wright-Patterson AFB. The new center will be staffed by military and civilian personnel with specialized experience in contract administration, property management, production, flight test, and quality control. The headquarters staff will supervise the operations of field detachments which will perform contract management functions at various contractor plant sites. The new center, to become operational in September 1969, will assume the contract management responsibilities formerly accomplished by AFLC AMAs.



Filled with inert gas, this eight-arm plastic bag is used by the AFLC's Oklahoma City Air Materiel Area, Tinker AFB, Okla., to repair titanium jet engine inlet guide vanes.

Scope of the Logistics Business

The logistics business is one of the most vital, sophisticated, massive, and important businesses in the Air Force. It touches every aspect of the Air Force. It involves billions of dollars and it has become, since World War II, one of our most complicated and essential professions.

For example, the financial program for AFLC logistics totaled $8.4 billion in FY 1968. Approximately 9,000 aircraft were repaired and about 14,000 engines were overhauled. Component and accessory repair amounted to 2.8 million units. More than 15 million "retail demands" were received from AFLC customers. This, of course, considerably oversimplifies the millions of actions that are taken in the five AMAs and four specialized activities of AFLC, but it does give a frame of reference as to the scope of AFLC's operation.

Obviously it is impractical to describe everything that AFLC does, so this article will cover only some of the highlights. First, where have we been and how did we get here from there? Then, we will review the logistics performance in Southeast Asia, some of the lessons learned there, and how we are making use of them. Finally, some of our plans for the future will be discussed.

Description of where we have been needs only the recollection of World War II and its story of mass logistics. We moved supplies overseas by the hundreds and thousands of tons. The more supplies we got over there the more difficult it became to keep track of them. We could not even count a lot of it. We did not know what was in some of the boxes. That is the story—in over-simplified form—of what happened. This is the kind of logistics the Air Force has been striving to get away from ever since World War II.

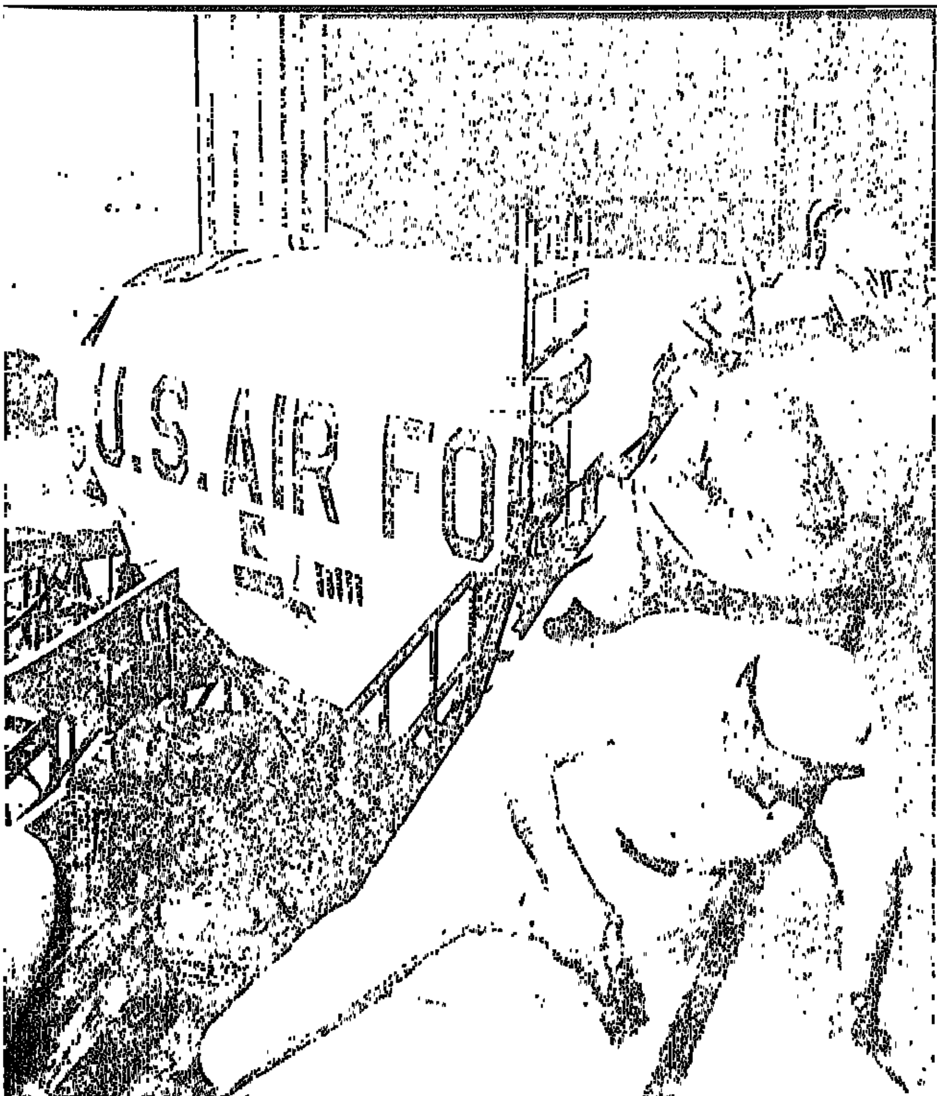
At the end of World War II, and for a period thereafter, we had a great many depots in the United States and overseas. We recognized that the materiel in those depots and in the pipeline represented a potential savings of great magnitude, if we could supply overseas units from installations in the continental United States. Increased airlift capability, improved high speed communications facilities, and the conversion of manual supply systems to automatic data processing equipment made it possible to begin the phase-out of many depots in the United States and overseas in the mid-1950s. By the end of the decade, all overseas depots had been closed.

Even in the United States, a number of installations have been phased out and the phase-out of the Mobile AMA reduces AFLC's operational activities to five air materiel areas and four specialized activities.

During the past 10 years, the dollar value of the operating fleet has gradually increased, from $20 billion in 1958 to $31.2 billion in 1968. Today's weapon systems—more efficient than their predecessors—are also much more complex and much more costly. This change created the need for more sophisticated spare items and test equipment.

Although aircraft and missile value has increased by 50 percent, the supporting spare parts inventory value in 1968 was $12.2 billion compared to $12.7 billion in 1958.

Ten years ago there was 64 cents in spares supporting each dollar's worth of operating aircraft or missile. Today, only 39 cents is needed, and yet our weapon systems are ready



A SAC B-52, just returned from action in Southeast Asia, is given a routine periodic IRAN check at the AFLC's San Antonio Air Materiel Area, Kelly AFB, Tex.

to perform their mission a much greater percentage of the time—79 percent compared with 65 percent 10 years ago.

How has this been achieved? Major factors have been improved communications, improved computer systems at the bases and the depots, and greater accuracy in inventories and in world-wide responsiveness.

During the same period, as weapon systems became more complex, the number of line items in inventory increased to a high mark of more than 2 million items at the start of the 1960s. Since then, although more complex systems have been introduced into the inventory, a highly concentrated effort to purge old items has been in effect, resulting in a reduction in the number of line items to about 1.7 million at the present time.

Early in the 1960s, the Defense Supply Agency (DSA) was created to increase efficiency of, and reduce the cost of managing, common military supply items and logistic services by eliminating overlapping and duplicating organizations, systems and procedures of the Military Services. About 800,000 Air Force common items have been turned over to DSA, leaving the Air Force with about 900,000 items for which AFLC has sole management responsibility. Basically, the Air Force has retained for management the complex items, the technical items that require specialized engineering support to manage.

Logistic Performance in Southeast Asia and Lessons Learned

The best measure of Air Force logistic performance in Southeast Asia is the fact that our units there are flying two or three times their normal flying-hour program under tough circumstances, and doing it successfully. Not-operationally-ready-supply rates are lower than ever before in the history of the Air Force.

A point to consider is that AFLC has a professional force of logisticians. The day has long since gone when you could take a new second lieutenant, put him out with the supply sergeant and have him learn the business in a few weeks. Today's logistic operation is a sophisticated and highly specialized business, and the people involved must know what they are doing.

Despite the necessary emphasis on Southeast Asia, the logisticians' professionalism has enabled AFLC to increase the effectiveness of its support for Air Force units world-wide. Aircraft, missiles and equipment during this period—wherever located—have been maintained at the highest level of operational readiness.

Lesson One—Maintaining Production Base for Munitions.

Now some of the logistics lessons that have been learned in Southeast Asia.

First, the Air Force, in the early 1960s, had some problems to solve in making the conversion from the strategy of massive retaliation to that of controlled or selective response. Those problems had not been solved when the Southeast Asia buildup occurred. The problem can best be illustrated by discussing the munitions situation.

At the beginning of operations in Southeast Asia, approximately 300,000 tons of conventional munitions were in storage but there was a very small production base. Suddenly we found ourselves in a conventional war and things had to start moving, including production of munitions. Fortunately, the Army and the Navy had saved some tooling and it was possible to reactivate production rather quickly. Production began to exceed consumption in the spring and summer of 1966. Inventories got pretty low, but were never actually exhausted. Some component shortages were experienced at individual bases, such as arming wires, fins and fuzes. Our shortage, technically, was a distribution shortage.

At present the production position

AIR FORCE LOGISTICS COMMAND

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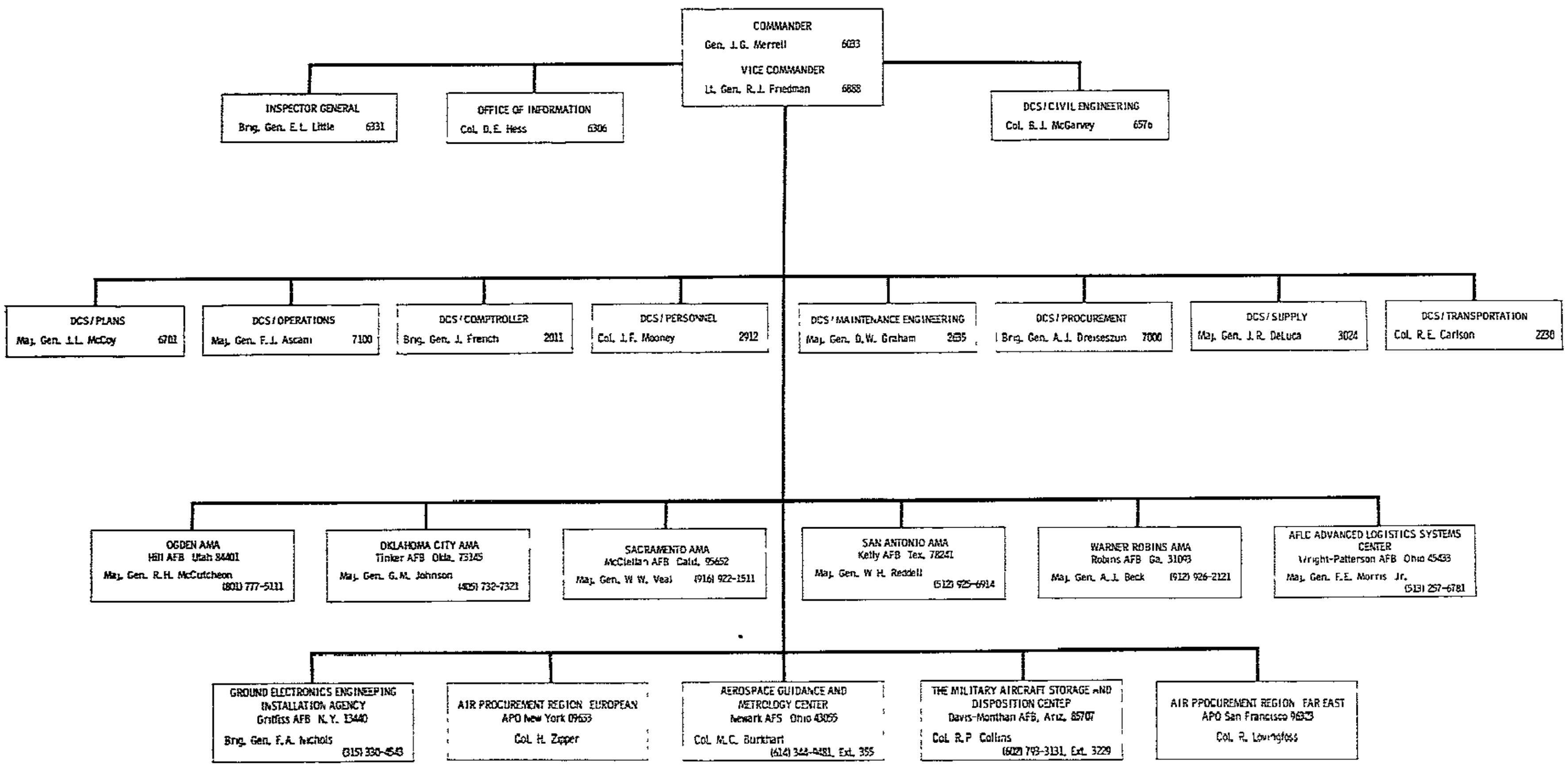
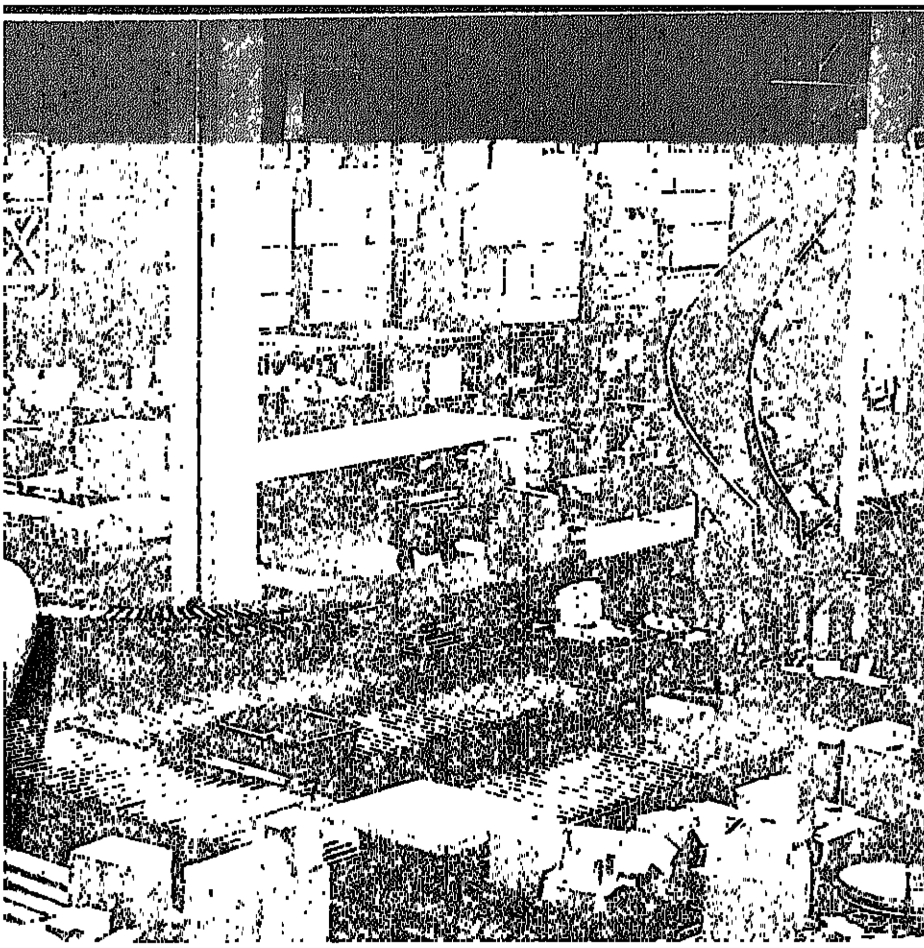
Editor's Note Organization charts appearing in the Bulletin are edited by the editorial staff to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizational elements not involved in the DOD-industry relationship have been eliminated because of space limitation

The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.





Automatic handling and conveyor lines at the Oklahoma City Air Materiel Area (OCAMA), Tinker AFB, Okla., warehouses. OCAMA receives approximately 7,000 tons of materiel each month.

is a comfortable one. Even so there were problems in converting from a static system to an active one. Pipeline and inventories had to be controlled to permit movement from the factory, to the storage point, to the shipping point, on board specialized ships, and, finally, in Southeast Asia. Control was necessary at the off-loading point, at the base, on the base to the airplane. A lot of learning was needed to achieve smooth operations.

Now our problem is to keep an active production base in the future. That is the first lesson learned. A very good reason for maintaining production as close to consumption as possible is to prevent excesses in munitions after Southeast Asia.

Lesson Two—Maintaining Production Base for Aircraft.

Lesson number two also concerns a production base—for aircraft. When the buildup began in Southeast Asia, there was a very narrow production base. As a matter of fact, there was only one real production line going—the F-4—and that line was shared with the Navy. Fortunately, working with the Navy, the Air Force had taken some preparatory actions with the contractor and some of their suppliers to increase production. A mobilization effort was developed which banked the production line with parts to allow the production rate to be increased as rapidly as possible. Even with these precautionary actions, a period of almost a year and a half was needed to double our aircraft production.

From this experience it is evident that even with a planned production acceleration, the task cannot be achieved quickly. Therefore, in order to be prepared for conventional contingency conflicts, larger tactical air forces—both men and aircraft—are needed. Then, some attrition, between the start of the contingency and the time that production of aircraft and crews can catch up, could be sustained.

Certainly, more aircraft could be bought and put in cold storage for a contingency. That would be very expensive, but it could be done. However, there is no way to put crews in cold storage. The better solution seems to be larger tactical forces. That is lesson number two.

Lesson Three—Need To Provide Instant Runway Capability.

The base situation in Southeast Asia provided lesson number three. At the outset we were confronted with some difficulty in moving our forces within Vietnam, and such bases as Tan Son Nhut, Bien Hoa and Da Nang were crowded. But troop movement was accomplished in a relatively short time and our forces were operational in a matter of days after arrival. However, the main problem arose when existing bases got so crowded that new ones had to be built. It took a year to build new bases, such as Cam Rahn Bay and Tuy Hoa.

The Air Force, tactically, requires a capability to move into not just a bare-base situation in a matter of hours and operate; actually we must be able to move into a "no-base" situation, where only the real estate is available and be able to create a base within a matter of days. This can be done by making full use of our future air logistics capability.

In this regard, a number of projects are being pursued, working with all the agencies involved. For example, in conjunction with the Air Force Systems Command, vertical structures are being developed, which are lightweight, very durable, and can be erected quickly. With the Army, work is in progress on airfield paving materials that will enable creation of a quick runway capability. Time will be drastically compressed by airlifting and air-dropping the equipment required to do the job.

From the standpoint of logistics, these, then, are some of the important lessons we have learned in Southeast Asia. Solving them was not easy, but we did solve them—by application of professional military and civilian talent and the effective use of data processing machinery.

Plans for the Future

Looking ahead, there are several important things to accomplish. First, there is a great need to modernize

our physical plant for the future—as far ahead as the 1980s.

Obviously, it is not a simple matter to see that far ahead. For example, we do not know what kind of weapons we are going to have then. Experience tells us this much. Yet, some of the older weapons may still be around. We do know enough, however, about the technology of the future to predict the kind of physical facilities that will be needed. Accordingly, a master plan in this area is now being developed. This is being done centrally, at AFLC headquarters, with the air materiel areas providing their input.

Improving Logistic Support Responsiveness.

Probably the most important AFLC project for the future is a program to improve logistic support responsiveness. Toward this end, the Advanced Logistics Systems Center has been created at AFLC headquarters, on a command level equal with the air materiel areas.

The center has the job of developing what we think of as a 21st Century logistics system—and the requirement to make this system operational during the early 1970s. To explain our objective in simplified terms, AFLC is a major user of computers. Computers now used by AFLC are second generation equipment, however, limiting the flexibility needed to improve our logistic management. For example, we need immediate access to storage data and real-time processing of transactions. Consequently, we are now looking toward third generation equipment.

Fifteen years of experience with computers provides the command knowledge of some of the difficulties involved in using computers to do a job. Our plan, in the Advanced Logistics Systems Center, is to develop specifications for, to obtain the "third generation" computers required, and to modernize our logistics processes. Through communications that exist today, and through computers that exist at most of our bases throughout the Air Force—properly programmed with software—we have the ability to develop a "closed loop" logistics system for all the items in the Air Force inventory.

The benefits of a "closed loop" system can be described simply. AFLC will have the capability at the item manager level in a depot to punch a button and ask for the condition, status, quantity and location of any single item, at any base, anywhere in the world. Our goal is to get the information on a near real-time basis—a delay of not more than one-half hour.

Achievement of this system will permit better management of Air Force logistics. Losing visibility of assets in the AFLC inventory is one of the major problems today. As long as the depots do not know where all assets are, they are just as unavailable as if they had never been bought.

With immediate access storage and real-time processing, the new equipment will make possible the maintenance of logistics data in what could be called a unified data bank. It will be accessible to Air Force operating units around the world, as well as to AFLC managers. Decisions by the weapon support manager, the buyer, and the maintenance manager will be based on a current single source library of data. Much of the current redundancy will be eliminated.

In a nutshell, attainment of improved visibility of assets, and the ability to respond more promptly and accurately, will better support the Air Force at a lower cost in inventories and operations.

Improvement of Item Repair Program.

Another AFLC program, already in being, is called AFRAMS (Air Force Recoverable Assembly Management System). This program's purpose is to maintain a "closed loop" system on about 77,000 repairable type assets representing about $5 billion worth of spare parts. Through this system, reports from all bases, world-wide, furnish status changes on these items as they occur. This permits the item manager to know, once he has the initial inventory, the status change of each repairable type item, by line item, on a world-wide basis.

With knowledge on where his assets are, he knows how many repairables he has, permitting better programming of repairs at the depot level and control of assets and their redistribution from base to base. This system is still in the early stages, but it represents a definite forward step.

Why do we need a more responsive system with fewer assets and fewer dollar spent? There is always an imperative requirement to reduce the cost of support of the Air Force. Reducing that cost makes possible more Air Force research and development and more urgently needed modernization for the future.

Many of our aircraft are getting very old. Statistics show that at the end of 1968 about 60 percent Air Force aircraft were more than nine years old. Improvement of the rate of modernization of our forces is a vital concern, and a primary reason for seeking ways and means to do a better job at less cost.

Improvement of Reliability of Weapon Systems.

Another area of concern at AFLC is improvement of reliability of the new systems being acquired. Our approach to reliability is in a quantitative sense.

In order to improve older aircraft, we have a program called IROS (Improved Reliability of Operational Systems). We are taking an analytical approach to the weak links in each one of the weapon systems in the inventory, and analyzing the deficient items with a view toward developing a systematic reliability improvement program.

We want to find the items that are causing flight safety problems, those that are causing high maintenance manhours, and high repair hours. With an orderly approach in detecting these deficiencies, we can attain a high order of magnitude improvement of reliability in many of the systems and subsystems that we have.

To illustrate, we have a tire on one aircraft that has been used for some time. Since 1962, through great effort, a contractor working with the Air Force has doubled the life of that tire, *i.e.*, from 5 to 10 landings before wearout. We do not know what the practical top limit is, but we ought to get up to 100 landings on those tires before wearout.

As another example, there has been enough improvement in the state of the art in electronics, in recent years,

to give us much greater life in electronic systems, radios, and other gear than we are now getting. We are being plagued with high failure rates of even 25 hours between failures. We ought to be getting 2,500 hours between failures. Much work is being done on the systems, that will remain in the inventory, to get these failure rates improved. This again will reduce our support cost which of course, is essential. More important it will improve the operational capability of our forces.

Improving Mobility of Forces in the Future.

To improve our support in another area, we have organized in AFLC a division to work with Headquarters, U.S. Air Force, the Tactical Air Command, the Military Airlift Command, and the Air Force Systems Command on the tactical and overall mobility of the Air Force. This division has the goal of substantially improving the mobility of our forces in the future.

A vital factor in improving the mobility of forces is the C-5A and what it is going to do for our capabilities. When we have a full inventory of these aircraft, we will have four times the airlift capability that we now have. C-5A type airplanes will create a revolution in air logistics, and in preparing for it the Air Force has a great deal of work to do.

Another factor is the improvement in capability of the Civil Reserve Air Fleet which will also be modernizing with newer aircraft, such as the Boeing 747 and Airbus type aircraft. That will give us a tremendous increase in airlift capability in any emergency of the future.

As I have said, we must be prepared for this kind of evolution in air logistics. We must also be aware of the reason why we should use this capability in peacetime. One of the great gains to be achieved will be the reduction in airlift cost per-ton-mile. Our costs have been steadily decreasing, with today's direct operating cost of military airlift at less than 10 cents per ton-mile. The capability of the C-5A gives evidence of a direct operating cost at about 4.5 cents per ton-mile. Obviously, when this rate is reached, many more items will be eligible for airlift from a strictly economic point of view. We are studying this now with the Army and the Navy to determine the additional items that can be airlifted.

The Air Force currently moves about 10 percent of its cargo other than liquids, such as fuel, petroleum and lubricants, by air. It is likely that in the 1970s, we will airlift 25 to 30 percent just because it is the economic thing to do. From the standpoint of contingencies, a greatly increased capability to move large forces quickly can be visualized.

Great emphasis must be placed on research and development planning for this effort for the future, in order to take the utmost advantage of our increased airlift capability to provide greater mobility for our forces.

AFLC Procurement Policy

Air Force Logistics Command procurement transactions currently amount to approximately $2.7 billion annually. It is difficult for the man in the street to comprehend the magnitude of defense procurement and its impact on American society. The Mahon Committee, in a report issued on July 18, 1968, commented as follows on this subject:

> The magnitude of defense procurement and logistics activities and policies are such as to directly affect every state and, directly or indirectly, the vast majority of the American people. In 1967 alone, defense prime contract awards totaled $44.6 billion and encompassed 15.1 million separate procurement actions. Inventories of weapons and equipment in use in this same time frame amounted to $95.5 billion. . . .

These staggering sums of public money impose a sacred trust and responsibility on all of us who handle them. Every administrative device we can develop and apply is used to assure that the best interests of the nation are protected and served.

The Mahon Committee noted this enormous responsibility in its report:

> The basic objective of those charged with the administration of a program of this awesome magnitude is to secure prime quality equipment and weapons systems at reasonable costs and in an efficient manner. The most effective way yet demonstrated to achieve this objective is through timely, competitive procurement . . . maximum effort must be made by defense procurement and contracting officials to assure the acquisition of new systems of desired quality at fair and reasonable prices to the government.

The objective, so clearly outlined in the Mahon report, is the guiding principle behind the procurement policies of AFLC. Our major objective has been, and continues to be, "provide timely support of our operational requirements without sacrificing sound procurement practices and goals." Effective management, both on our part and that of our contractors, is a must. Of course, regard for the public interest must always be our primary concern; nevertheless, we must always assure that fair and equitable practices govern the buyer-seller relationship.

This article has discussed at great length systems, programs, problems, machines, aircraft, and policies, relating to logistics management in the Air Force. The discussion would be incomplete without recognizing an important single resource which outweighs and overshadows everything else. This is people—military and civilian, men and women, in Government and in industry. It is the logisticians in the Air Force and in industry who solved the problems I have discussed and it is their skill that will solve the future problems.

Someday there will be third generation computers and after that a fourth generation. The C-5A system, the Airbus, and the heavy lift helicopter—and only the most imaginative can foresee what is beyond them —will be part and parcel of a vastly complex and uniquely different logistics system from what we have today. We must have sophisticated and highly trained human resources fully prepared to meet that day.

Logistics is our life's blood; without it we cannot live. It is immense, it is complex, and it is vital.

Some Observations on Integrated Logistic Support in the Air Force

Lieutenant Colonel Edward G. Sperry, USAF

A system is a big black box
Of which we can't unlock the lock,
And all we can find out about
Is what goes in and what comes out.
—Boulding

Would you believe that the following quote is an extract from a current Air Force approach to integrated logistic support?

> "... it provides a means for developing hardware, facilities, personnel and procedural support information on a concurrent and integrated basis, minimizing oversights in design, optimizing design, reliability and minimizing costs. ... procurement of vast quantities of hardware which is utimately determined to be unnecessary, and generating requirements for extensive modification programs can be eliminated through implementation of this plan ..."

Actually, the words were written in 1960. They are from the Systems Engineering plan for the Minuteman missile system.[1] This article on integrated logistic support (ILS) begins with mention of systems engineering because of the absolute necessity that logistics and engineering disciplines effectively interact. Systems engineering and ILS relate conceptually as is shown in the DOD ILS Planning Guide.[2] For our purposes, description of the relationship can be even further condensed. Specifically, logistic personnel must be able to express their needs to the systems engineering process which must, in turn, be able to define and optimize the total system. ILS personnel must be participants in the process and use the products of systems engineering to insure a common baseline for logistic elements. Perhaps this is belaboring the obvious, but it is essential that ILS not be considered as a separate entity divorced from the other elements of systems management.

This discussion will develop three aspects of ILS. First, we will review the environment concerning policies and procedures which must exist to enable logisticians to express their objectives and effectively participate in acquisition management. Second, we will consider the contributions logisticians have to offer. Finally, some comments about the logistic participant.

ILS Role in System Acquisition Management

To paraphrase Archimedes—the logistician could move the universe if he could find a place to stand. His place to stand is the product of basic policies and procedures of the Air Force. ILS is inherent in the very concept of systems management. In the case of the Minuteman missile we achieved the objectives of ILS. In other cases we have not as quickly achieved the desired degree of support. Therefore, our policies and procedures have been under review.

Headquarters, U.S. Air Force, Air Force Logistics Command (AFLC), Air Force Systems Command (AFSC), and Air Training Command (ATC) have been developing the necessary changes. Two significant decisions have already been implemented. First, during the conceptual phase, AFLC now makes a provisional determination of which air materiel area will support the weapon system. Second, the initial System Program Office (SPO) cadre now includes a deputy system program director for logistics. He will carry the integrated logistic responsibility into contract definition and through acquisition. Recently established program offices, such as the Airborne Warning and Control System (AWACS) and F–15, have this arrangement.

The F–15 has also been subject to a task force for assuring that ILS considerations are covered in the acquisition contract. Lessons learned

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[1] *Space Technology Laboratories, Inc., 6600.33.118, Nov. 18, 1960, "Description of the Minuteman System Engineering Plan."*

[2] *"Integrated Logistics Support Planning Guide for DOD Systems and Equipment," Oct. 15, 1968, is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, for $3.75. Defense contractor managers can obtain copies through their cognizant military contracting offices.*

from the task force will be applied to subsequent systems. Task forces will also be used for a missile and an electronic system in order to ferret out peculiarities.

Staff assessment of ILS implementation requirements, experience from the task groups for specific systems, and experience of the SPO deputies for logistics are all being used to determine how the Air Force should revise its basic regulations and procedures to more adquately implement ILS.

Changes are required in regulations which govern conceptual, contract definition, and acquisition phases. Changes will probably also be required in selected functional regulations pertaining to the various logistic elements. As the basic Air Force regulations change, reaction will be necessary at lower and lower echelons. The policy and procedural overhaul will, therefore, take some time. This may be better understood if we examine the requirements which must be met.

ILS, as delineated in DOD Directive 4100.35, requires integration with other management subsystems that govern hardware design and procurement as well as logistic support. In this context, ILS implementation can be likened to a design task which is subject to design requirements. Foremost is obviously the basic directive which contains the definition of ILS, the need for a ingle individual responsible for ILS natters, and the relationship of ILS o system/project management. However, design of policies and procedures to meet DOD Directive 4100.35 is constrained by other requirements, many of which are not normally considered as logistic in origin (Figure 1). As an example, specific consideration should be given to the following:

- DOD Instruction 7000.2 which clearly expresses the requirement to use contractor internal management processes, as opposed to imposing government procedures. The contractor processes should be validated against criteria to assure their adequacy.
- DOD Instruction 7000.6 which expresses requirements for control over new or revised contractual management systems.
- DOD Instruction 7000.7 which expresses requirements for control over application of management systems to specific programs; whereas DOD Directive 5010.23 expresses policies requiring flexibility in the selection of tailoring of management systems for any research and development project (including major system acquisitions).
- DOD Directive 5010.14 which establishes the framework of system/project management requiring a single responsible manager for the entire system.

Two other essential ingredients in the requirements mix remain to be identified. They are the flexibility of contract approach, ranging from cost-plus-fixed-fee to fixed-price-incentive; and the variations in the program definition techniques which may be exercised.

At risk of breaking our train of thought, the latter warrants additional explanation. There is growing concern that contract definition paper analyses are not defining contract requirements to the point where cost schedule and performance commitments can be realistically confirmed between the Air Force and industry. There is more and more interest in continuing the definition process through the initial competition of prototypes. Whatever policy and procedural changes the logistician creates, he must accommodate this potential shift. For all its advantages, contract definition, using prototype competition, will cost more than paper analyses. Increased costs may create a temptation to restrict the competition to consideration of only key performance parameters. We must assure that key logistic requirements are among these parameters; otherwise, we will have come full circle and find ourselves, once again, forced into the inefficiencies of accommodating support requirements through engineering changes.

Considering the variations that exist within each of the management requirements described in the foregoing, it becomes apparent that there is no universally applicable way to implement ILS. The program director and his logistic deputy must be provided various means of implementation and authority to select those appropriate for the specific program.

The Air Force encountered the same situation during the development of an approach to systems engineering management. A long line of procedural documents (starting with the systems engineering instructions for Atlas, Titan and Minuteman) finally culminated in Air Force Systems Command Manual 375-5. The manual describes a rationale and process for systems engineering which is essentially the generalization of processes developed during ballistic missile acquisition. Its first application was on the C-5A, a total package procurement program. It was soon recognized that a procedural manual, prescribing definite techniques, formats and in-process approvals, was incompatible with the C-5A's total package procurement concept using a fixed-price-incentive contract.

Accordingly, the Air Force has been developing a military system engineering standard. The standard allows contractors to use their individual management techniques, once these techniques have been validated against prescribed criteria. The standard does not replace the engineering manual. A manual is still required, as are handbooks and validation techniques. Fortunately, the elements addressed by systems engineering are also the elements addressed by ILS. Therefore, development of ILS processes can capitalize upon the several years of effort in developing flexible techniques for systems engineering. Also, the systems engineering standard will be the basis of technical performance measurement of key contractual logistic parameters.

The Logistician's Contribution

To this point, we have seen that the logistic environment is being improved. Success is partially dependent upon continued improvements in systems engineering management and in steps taken to assure that logisticians have flexible techniques commensurate with the varied approaches available to the development community.

Earlier we paraphrased Archimedes concerning a place for the logistician to stand; now let us consider the lever he will use when the scaffold is provided. How does he contribute, bring leverage to bear? He must assist in quantifying the logistic effects of the design process. His procedures must spell out "how" to quantify logistic effects in dollar terms. Yet, the ability to quantify projected support requirements so that the results of design efforts can be evaluated is what is lacking. Without quantification of these effects, false credence is given to minimizing

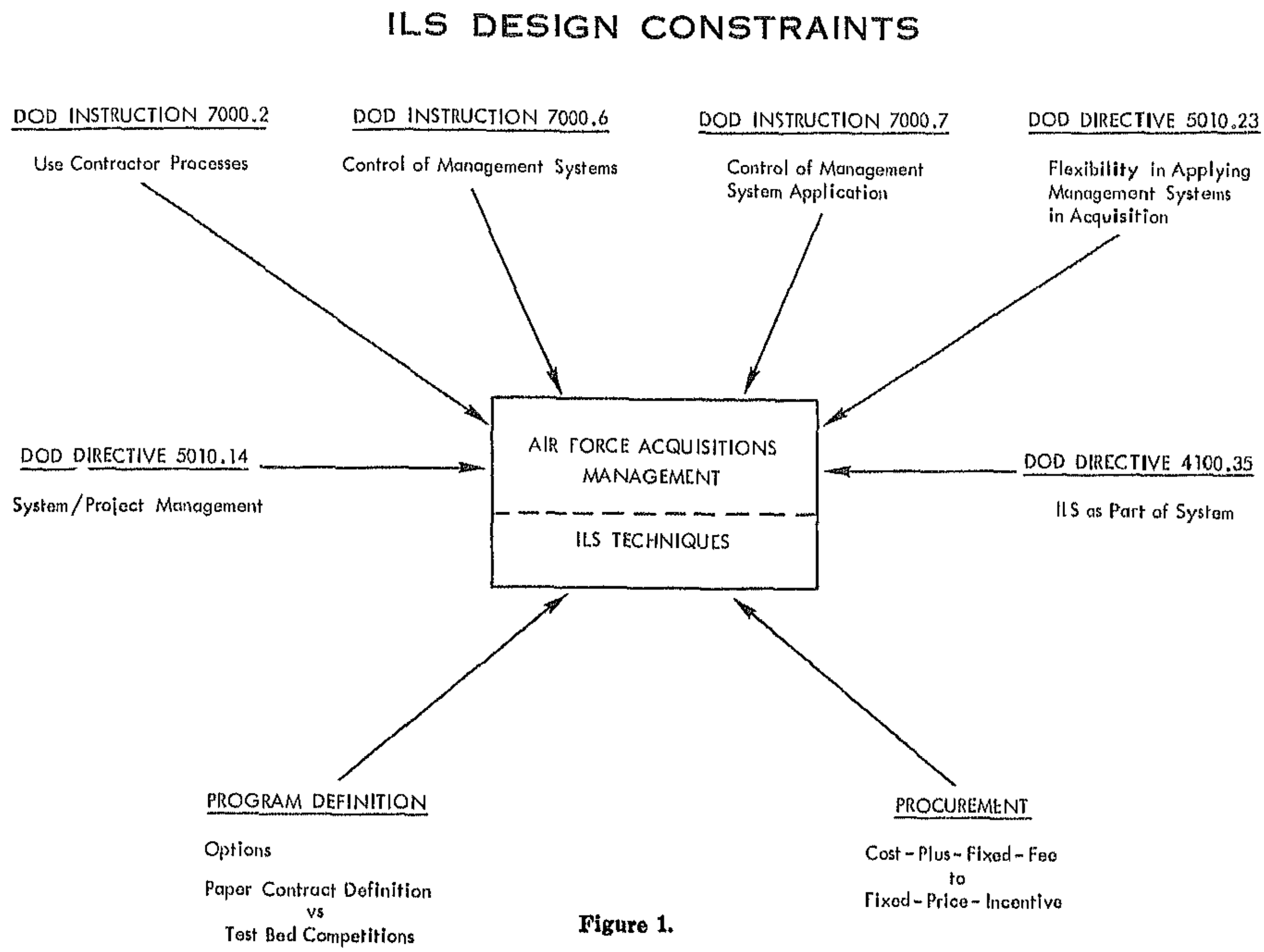

Figure 1.

initial development and acquisition costs.

The inability to properly quantify logistic effects and establish demonstrable contractual goals has resulted in adverse support conditions. In such cases, the users live with low system availability, high repair rates, retraining, and multiple configurations. The logisticians compensate with extra resources for spare parts, repair labor, and hardware modification programs. The resulting expenses create unfavorable publicity and a generally difficult "fishbowl" management climate.

The objectives of ILS will not be achieved until the quantitative aspects of the complex decision processes are more fully developed. In this connection, one recent development by the AFLC offers great potential. It is a project—called Project ABLE—of the Operations Analysis Office of Headquarters, Air Force Logistics Command. The project is being intensively examined in relation to potential applications by the Deputy Chief of Staff for Operations of AFLC headquarters, and is receiving formal assessment within the Air Force Systems Command.

Project ABLE is built upon a concept which is widely voiced, but which has heretofore been honored more by the breach than the observance: that decisions should be based upon *all the consequences* which will ensue. The project now contains specific mathematical formulae for measuring all the logistic consequences, ranging over traditional logistic costs (spares, repairs, test equipment, etc.) and including also such important weapon system characteristics as availability and dependability. The composite is quantified in a figure of merit called Total Logistic Effects. When the project is developed to its full potential, it should also embrace non-logistic consequences, including such capability variables as range, payload, bombing error, etc.

Since the key variables in these logistic formulae will be the result of the contractor's success in reliability and maintainability, Project ABLE calls for each bidder to make his own projection of these total effects. The Government treats each such projection as a contractual target—Target Logistic Effects (TLE). The TLE is considered in conjunction with each bidder's targets for development and acquisition costs, performance capability, and in source selection.

At predetermined stages in the development and production cycles, the contractor will be subjected to specific demonstration and test requirements. When processed through the same ABLE formulae as were used for targets, the test results will yield new estimates of the "total consequences" which are called Measured Logistic Effects (MLE). A comparison of commitments (TLE) and achievements (MLE) then becomes the basis for an incentive program in which the component parts have been so fully integrated that no possibility of imbalance exists.

As the winning bidder faces a myriad of design decisions and maintainability determinations, he can consistently use the MLE formulae as

his basis for tradeoffs. His MLE calculations provide the measure of payoff or benefit, against which he can consider alternative costs. Cost/effective decisions are then feasible. If the incentive program involves a "carrot and stick" combination which is suitably sized to reflect the dimensions of the Total Logistic Effects, there can be little question that the contractor's design personnel will be appropriately instructed to make his decisions on the basis of the MLE. When this happens ILS will be assured, for the decisions which are in the best interest of the contractor will be the very same decisions which are in the best interest of the Government.

From the logistician's point of view, Project ABLE is intended to make new systems better—sooner! From the perspective of the Air Force, the project seeks to facilitate the balance of operations and support. It contributes the quantitative tools which are needed for the tradeoffs that ILS endorses. The Air Force is vigorously involved in assessing and further developing this promising new concept.

Characteristics of the ILS Manager

Finally, what manner of man have we been discussing? Is there such a person as an ILS officer? This question is of concern to the Air Force and is being studied by personnel specialists. We will risk a few comments before the analyses are completed.

The ILS officer's task is management. There is probably no need for a superman who is capable of dealing with each of the logistic elements in depth. No one attempts this today in such multiple discipline areas as engineering, test, procurement and production. He will need the professional maturity to select and tailor whichever ILS management techniques are applicable to the specific program with which he is concerned. His background should probably be technical and analytical with experience in logistics. It will be necessary that his technical background be compatible with the design engineering and test personnel with whom he must deal. Given some experience such a man could be effective in either the AFSC or AFLC portion of a System Program Office. The ideal career development program may include cycling between development, test and logistic management tasks.

The renewed interest in logistics, whether under the banner of ILS or life-cycle costing is having a constructive impact upon Air Force policies, organizations and techniques for systems acquisition. Likewise, the Air Force's leadership in systems engineering, the tailoring of management systems to the contract environment, and in developing new techniques for quantifying logistic effects are major factors in advancing the objectives of ILS. We are becoming more and more capable of carrying out the intent of systems management which was once so succinctly expressed as the "prevention of random, piecemeal, accidental discovery of weapons systems."[3]

[3] Colonel John Chandler, Feb. 15, 1962, "Acquisition Management Aspects of Weapon Systems Analysis and CIC&A," AFSC Ballistics Systems Division, Inglewood, Calif.

GE Re-entry Systems First To Meet New USAF Cost Control Program

General Electric Re-entry Systems, Philadelphia, Pa., has become the first aerospace contractor to reach operational achievement of the Air Force Systems Command's Cost/Schedule Planning and Control Specification (C/SPCS), for the company's Minuteman III research and development program.

C/SPCS planning and control specification is an aspect of the AFSC's cost management improvement program, aimed at achieving cohesive Air Force-contractor management control systems. Instead of requiring a specific internal cost and schedule system or method, C/SPCS embodies a set of criteria which outline capabilities the management system must possess to satisfy Air Force requirements. It also encourages contractors to use a system best suited to their own internal needs, within criteria established by the Air Force. This approach is designed to provide early awareness and identification of possible problem areas.

In the past the Government specified particular systems for a contractor's use, which often resulted in the contractor operating one system for reporting to the Government, while using another system in the actual management of the contract.

Army Developing Larger CONEX Units

A larger version of the containerized éxpress container, or CONEX, widely used by the Army to deliver materiel to Vietnam, is under development by the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

The new CONEX is a corrugated sheet-steel container with a capacity of 13,000 pounds, 4,000 pounds more than the current model. It measures 8 feet long, 6 feet 8 inches wide and 8 feet high and has a volume of 350 cubic feet, compared to the 8 foot, 6 inch-by-6 foot, 3 inch-by-6 foot, 10½ inch older model that had 294 cubic feet in volume.

The improved version also features built-in high strength couplers, permitting three containers to be joined into a 20-foot unit that meets commercial rail, road and water standards. Loaded to its 44,800 pound gross weight it can be lifted by cable sling.

Doors of the new CONEX are crimped and plastic-lined for improved weatherproofing. A second version with the same capacity as the current model is also undergoing development.

Army Seeks Helo Rearming Vehicle

A weapons loading vehicle for the AH-56A Cheyenne helicopter is being sought by the U.S. Army Combat Developments Command (CDC), Fort Belvoir, Va., to provide rearming for the craft when its own hoist system has suffered battle damage or malfunction. Rearming is now being done manually, resulting in both loss of time and increased personnel risk.

The CDC proposal called for modification of the Army's "Mule" to provide it with one-ton hydraulic lift capability, with only a small loss of mobility. The proposal also set a hoist capability of 50 inches from the ground and a fail-safe feature to prevent load drop in case of hydraulic failure.

The loader would be airlifted into a battle area by either cargo aircraft or helicopter, and would provide rearming for Cobra and Huey gunships in addition to the Cheyenne. It would also double as a weapons and stores lifter for other aircraft.

Flexibility in Management of Research and Development

James W. Grodsky

The research and development program of the Defense Department is a very complex, multi-faceted organism made up of thousands of individual projects. The variations from project to project are extremely great, using almost any criterion one can imagine: size, complexity, kind of organization doing the work, degree of technology advancement sought, relationship to inventory use, urgency of operational need, etc. Although the research and development program as a whole has discrete objectives—utility of the end product and efficiency of the process, even the degree to which these objectives are pursued varies substantially from project to project.

Many individuals in the Defense Department have long recognized these substantial variations. However, others have not always been sufficiently flexible in applying management systems and techniques to projects which they control or influence. Newly issued DOD Directive 5010.23, "Flexibility in the Management of Research and Development," Jan. 14, 1969, addresses this problem. The objective of this directive is "to provide an environment in which a project manager is given the opportunity to select and tailor to the specific needs of his project those management systems and techniques that will help his project." This article is a summary of the policy enunciated by the referenced directive, and its rationale.

What Are Management Systems and Techniques?

Management systems include planning systems, control systems, and other systems used to assist managers (both in-house and under contract) to:

- Define or state policy, objectives and requirements.
- Achieve efficient and effective utilization of resources.
- Periodically measure program performance.
- Compare that performance against stated objectives and requirements.
- Take appropriate action.

Management techniques are similar to management systems, but tend to be formal, procedural methods which project managers use to achieve the objectives of their management systems.

The flexibility policy of DOD Directive 5010.23 applies only to those management systems and techniques (hereafter referred to as systems) that are described in a published document (either regulatory or permissive), such as a regulation, directive, instruction, handbook, manual, standard, specification, or similar document. This is limited to published documents since rigidity in management usually results from written rather than oral direction.

What Kinds of Problems Were There?

During the late 1950s and 1960s, numerous project management systems were developed by the Secretary of Defense and the Military Departments. Examples of such systems include contract definition, integrated logistic support, PERT and PERT/cost, systems engineering management, total package procurement, configuration management, and work breakdown structures.

In sum, these made up a "Chest of Management Tools" which could be very useful to a project manager. However, there were three problems:

- Management systems were sometimes applied to a project when they were not appropriate at all.
- They were appropriate, but were applied to a depth or a level of detail that was not appropriate.
- They were applied at the wrong time, *e.g.*, too early in the project's life.

The consequences of such cases of misapplication, particularly if more than one management system was misapplied on one program, could be very serious. There could be substantial increases in cost, project delays, and failure to accomplish the more important project objectives. In such cases, management attention could be diverted from providing answers to more critical project questions, such as: What are the objectives of the project? How can they best be achieved? How can unnecessary project costs be avoided?

To cite an example of misapplication, during the contract definition phase of a major program the systems engineering management procedures were followed at too low a level of detail for this phase of the program. This resulted in generation of a huge mass of paper. Only a small part of this paperwork was really useful in the source selection and program decisions made at the end of

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Relationship Between DOD Directive 5010.23 and DOD Instruction 7000.7

	Directive 5010.23	Instruction 7000.7
Kinds of projects to which applied:	All categories of research and development.	Production and later categories of development (engineering and operational systems development)
Organizations to which applied:	In-house and contractors.	Contractors.
Kind of direction:	Policy—to establish proper environment.	Procedures—to select management control systems.

Figure 1.

contract definition, and in planning the development program that followed. In particular, the detail of logistic-related efforts, which is absolutely necessary at some point in the program's life, was far greater than was necessary at that point in time. The result was unnecessary expense, dilution of the efforts that contributed most to the program at that stage in its life, and camouflage of the useful products.

What Were the Sources of the Problems?

These problems arose from environmental and attitudinal rather than procedural causes. They were a reflection of the total environment surrounding the development process and the attitudes of the people involved, particularly project managers, their staffs, and functional managers and specialists (reliability, systems engineering, configuration management, etc.). The major sources of these problems were:

• **Reliance on Specialists.** Project managers, being generalists, are usually familiar with special management systems only in gross terms, and they frequently must turn to a specialist in a particular management system for advice. The specialist is usually not unbiased. Rather, he is an advocate of the management system in which he is "the expert." This is quite natural and desirable. He has seen the advantages of the management system, hopefully has some real experience in its use, and has faith in its benefits. In some cases, particularly if he is not even on the project manager's staff, his knowledge of the project may be insufficient for him to evaluate the total influence—both good and bad—of the particular management system under consideration. Under these conditions, it is likely that a special management system will be applied to the project, and that the degree of application will err in the direction of too much rather than too little.

• **Attitude of Higher Authority.** A project manager's actions are influenced by what he *thinks* is the attitude of the higher levels of command in his own Department and in the Office of the Secretary of Defense toward a particular management system. All of the evidence that he usually has causes him to believe that they favor application of the particular management system. It is in the form of a written directive, a regulation, or a specification. Sometimes it is permissive, but usually even then it has some mandatory aspects. There may not even be provisions for waivers, in which case the project manager would logically assume that they will not be granted or that, at best, there is an unfavorable climate for them. Even if there is a waiver clause in the regulatory document, he may believe that this is just "window dressing" and the people responsible for deciding on waiver requests are generally unreceptive to them.

• **Inability To Evaluate Effects of Application.** Unless a project manager has had real-life experience with a particular management system which he can translate into anticipated effects on his current project, it is difficult for him to recognize the total impact—both good and bad—that it will have. Even if he does conclude that it will do more harm than good, he has to decide whether it is worth fighting about. He usually has a large number of other important problems in which he is, if not an expert, at least a very knowledgeable layman. He must select those few problems on which he will very often not choose to fight the application of a specific management system to his project, even if he senses that it will not really help him.

• **Decreasing Flexibility at Lower Organizational Levels.** There is a common saying: The farther down you go in an organization, the more rigid the policies and practices become. There is much truth in this. The rationale for a management system, for example, and the nuances of its application tend to evaporate as regulations for that system are passed down from the headquarters level to the command level, and on down to the working level. Without a good understanding of the true objectives of the policy makers, it is only natural that the working troops tend to use management systems whose worth on their projects they question or think is marginal.

• **Reliance on Systems Instead of People.** Several factors have pushed project managers into more and more reliance on managements systems, such as the difficulty in getting the numbers and kinds of people who will be most useful and the recognition that systems can be of help. What is sometimes lost sight of is that management systems are only an aid to people, but not a substitute for them. People are still required to evaluate information, to exercise judgment, and to make decisions.

• **Lack of Clear-cut Decision Authority.** Suppose that the project manager and a specialist on a particular management system disagree on whether that system should be applied, or on the depth of its application. Who makes the decision? In

some organizations this is not clearly the prerogative of the project manager, and disputes must move up the ladder for decision. Then the previously mentioned bugaboo appears. Where should a project manager spend his limited energies? When the project manager does not have the authority to determine application of management systems to his project, misapplication may occur because he feels he cannot afford to fight every problem that arises. It is our belief that when the pros and cons are about equal for application of a specific management system, the project manager's wishes should prevail. This coupling of authority and responsibility is necessary to achieve better performance on our research and development projects.

To sum up, for a variety of reasons, the environment that has existed has encouraged use of management systems even when they were not helpful to a project.

What Did We Do?

Since the basic problem was one of attitude and environment, our goal was not to set up procedures but rather to establish the proper environment—one conducive to selecting and tailoring management systems to the particular needs of each project. In line with this goal, the Deputy Secretary of Defense, in late 1966, approved the so-called "Chest of Management Tools" policy which was provided to the Military Departments in 1967. This formed the basis for DOD Directive 5010.23 which applies to management systems directly related to the needs of a project manager, including those levied by the Office of the Secretary of Defense on the DOD Components (Army, Navy, Air Force and Defense Agencies), higher levels of authority in the DOD Components on their project managers, and DOD Components on their contractors. It applies to all categories of research and development (research through operational systems development) without limitation as to size and scope of the research and development effort. Flexibility is particularly necessary for research and development because of the risks and uncertainties associated with such efforts, and the need for them to take place in an environment that stimulates creativity and ingenuity.

The "Chest of Management Tools" policy:

- Focuses on the project manager.
- Makes clear that only those management systems required by law or the Armed Services Procurement Regulation are mandatory.
- Calls for selective application of all others. Criteria for application are when the management system will "substantially benefit" the individual project, or when there are benefits that extend beyond the project itself.
- Recognizes the need for mechanisms for formal waiver approval from management systems required by regulatory documents.
- Stimulates considering each management system in the light of its total influence (pro and con) on the specific project before applying it.
- Calls for project manager responsibility for overall management of his project, with functional managers in a *recommending but not decision* position.
- Expects project managers to employ management systems that are obviously intended to apply across the complete spectrum of DOD activities, *e.g.*, budgeting systems, security systems, etc.

Relationship to Other DOD Policies and Procedures

The "Chest of Management Tools" policies are closely related and complementary to the policies and procedures of DOD Instruction 7000.7 (The Selection and Application of Management Control Systems in the Acquisition Process). The most important differences between DOD Directive 5010.23 and DOD Instruction 7000.7 are shown in Figure 1.

The focus of the "Chest of Management Tools" policy is on the needs of the individual project manager, in contrast to the broader aims of DOD Instruction 7000.7 and its companion DOD Instruction 7000.6 (The Development of Management Control Systems for Use in the Acquisition Process) which are intended to reduce unnecessary proliferation of management systems in Defense Department. DOD Instruction 7000.6 provides a formal procedure for development of new management control systems or substantial modifications of existing management control systems, and for the inclusion of such systems in a Management Control System List and an Authorized Management Control Systems List. In the near term, only systems on one of these lists can be selected for contractual application. Ultimately, only systems on the Authorized Management Control Systems List can be selected for contractual application and DOD Instruction 7000.7 provides a procedure for selection of management control systems from these lists.

The guidelines, principal considerations and standards of DOD Instruction 7000.7 and the Management Con-

Implementing Regulations of DOD Components

Department of the Army	Army Adjutant General Memorandum AGAM-P(M), March 6, 1969
Department of the Navy	SECNAV Instruction 5220.10
Department of the Air Force	Air Force Regulation [illegible] 30
Defense Communications Agency	DCA Instruction 630–50–3

Note: Contractor representatives who have need for copies of the DOD component implementing documents should place requests through their cognizant DOD contracting agency.

Copies of the DOD Directives and Instructions referred to in this article may be obtained without charge (one copy per requester) from the Naval Forms and Publications Center, Attn: Code 300, 5801 Tabor Ave., Philadelphia, Pa. 19120.

Figure 2.

trol Systems List of DOD Instruction 7000.6 should be useful to the research and development project manager in selecting and tailoring his management systems, but they do not comprise all of the tools for this task.

What People Are Affected?

The greatest impact of the "Chest of Management Tools" policy is on research and development project managers, both those within DOD and those working for DOD under contract. It provides them with a clear signal from the top management of the Defense Department: Take the initiative to do what you think is best for your project. DOD policy and the implementing regula-tions from the DOD Components ee Figure 2 on page 15) can be used project managers as the basis for lecting and tailoring the manage-ent systems that will help their proj-t. We are hopeful that project man-gers, both in Government and industry, will actively seek waivers on those management systems, or parts of them, that are inappropriate whether they are promulgated by the Office of the Secretary of Defense or by a DOD Component.

Since the aim of the overall policy flexibility, it is incongruous to pre-ribe a single, rigid procedure for taining waivers. Therefore, several ternative means are suggested in e policy directive. One means which ems eminently sensible is to use the magement plan portion of a de-lopment plan as the vehicle for this. entification of the management sys-ms in the development plan for an dividual project, together with entification of those systems for hich waiver is required and the rea-ons for waiver, permits overall re-iew and approval of the manage-ment plan without the necessity for waiver of individual management systems.

Management systems and techniques are referenced, and guidance or direction for their use are provided in a very large number of documents within DOD. These documents occur at many different levels: the Office of the Secretary of Defense, the headquarters of the Military Departments, the commands, etc. In order to provide an environment *for the project manager* promoting flexibility in his management, the many documents that he sees and uses must reflect flexibility. Therefore, during the next year or two, these documents must be reviewed and changed to assure that documents that the project manager sees and uses provide a homogenous environment of flexibility.

In order for the "Chest of Management Tools" policy to be successful, the people directly involved in considering the application of a specific management system to a specific project, and those in the chain of command for waiver requests (everyone in the path from the level immediately above the project manager to the authority who will make the waiver decision) must be receptive to the philosophy of flexibility. In addition, of course, the specialist in the particular management system that is being considered can make a unique contribution because of his specialized knowledge.

This amalgamation of the specialist's knowledge in his area of concentration and the overall view of the project manager is necessary to achieve efficient management, tailored to the needs of an individual project. In any program flexibility is desirable. In a research and development project, it is essential because of the inherent uncertainties that are characteristic of research and development, particularly the so-called "unknown unknowns" which become visible only as the work progresses.

When we adopt a flexible attitude toward the application of management systems to each project, we can limit our problems to those dictated by the physical environment. When we adopt an inflexible attitude, we add to these problems others of our own creation. The Secretary of Defense has established the flexible attitude as the official policy, but he needs your assistance to translate the policy into practice. Will you help?

DSA Reports Cases of Laxity in Security Review Procedures

Inadvertent release of classified information in advertising and various publications by Defense Department contractors has been pointed out by the Office of Industrial Security, Defense Supply Agency. The office reported that some contractors are not strictly following the provisions of paragraph 5n of the Industrial Security Manual for Safeguarding Classified Information (Attachment to DD Form 441) and not assuring that their standard practice procedures comply with requirements of the manual.

In one case a contractor furnished his advertising agency two versions of advertising copy. One version had been reviewed and approved by the user agency; the second had not been approved for public release. The advertising agency chose the disapproved version and published it. Contractors are reminded to ensure that required security review is accomplished before information is given to an advertising agency, and that strict attention is paid to the security system to ensure that it works.

In a related case, a contractor published unclassified information concerning classified information in a house organ without having submitted the article for review. Instead, FOR OFFICIAL USE ONLY was printed on the cover. Since distribution of these publications is usually random, the warning was useless. The proper procedure would have been to submit the article for review by the activity specified in Item 12 of the Contract Security Classification Specification (DD Form 254, July 1, 1967).

New Subscription Service Offered by Commerce Department

A new subscription service for obtaining microfiche copies of scientific and technical documents by field of interest is available from the Commerce Department's Clearinghouse for Scientific and Technical Information. The new service, Selective Dissemination of Microfiche (SDM), offers to customers unclassified reports and translations of foreign technical literature in any of several hundred categories.

By offering copies by subject category, originating agency and subject category within an originating agency, the service will eliminate the need for individual orders for documents.

SDM distribution will be made twice each month. Information on categories, cost and ordering methods can be obtained by writing Clearinghouse (152.12), U.S. Department of Commerce, Springfield, Va. 22151.

Crew Chiefs Upgrade System Support

Major General Fred J. Ascani, USAF

The continuing shortage of research and development money, combined with the same lack in the area of acquisition, precludes timely modernization of the existing defense force structure. This makes it mandatory that increased emphasis be placed upon the continued reliability and supportability of current Air Force weapon systems and subsystems. It is evident that improved management effectiveness will be required if these objectives are to be attained.

To overcome these limitations—and to provide the necessary managerial capability—the Air Force Logistics Command (AFLC) developed the AFLC System Manager Program to assure adequate monitoring of Air Force systems throughout their life span, from development through phase-out. The program is designed to upgrade AFLC's support of weapon systems, but at the same time to stay within current constraints—budgetary and others.

Within AFLC, the individual designated to perform this function is the system manager, known in-house as the "crew chief."

The system manager is supposed to be *the* expert on his system. He is expected to know its status and health at all times. His relationship to his system is roughly the same as that of a crew chief to an individual aircraft; hence, the nickname, "crew chief," for AFLC's system managers.

As the AFLC commander's personal agent, the system manager speaks with command authority in matters pertaining to his assigned system.

Basically, the system manager has total responsibility for the system he manages. He is the single individual in AFLC who can be called upon to answer every question about his system: the design aspects and production status of all components; its performance characteristics and operational employment; its deficiencies and any remedial action required; the financial aspects and status of funds; in other words, the complete logistic story of his system from conception to phase-out.

A close relationship with other Air Force units is maintained at every stage of a system's life cycle.

Logistics Considered at Every Phase

From the beginning, the system manager influences design by providing logistic requirements, intelligence and constraints to the developing agency. During the contract definition phase, he assures that logistic requirements are built into the acquisition contract. During the acquisition phase, he insures that logistic requirements will be satisfied.

As the system enters the operational phase, he maintains constant surveillance over it, seeking to improve the basic design and to assure that the using activity operates and maintains the system within its capabilities and those of the logistic system. One of the most important tasks of the AFLC system manager is to develop an effective logistic response capability for the first operational unit and all subsequent organizational activations and conversions.

Working closely with the prime contractor, subcontractor, vendors, using activities and, particularly, the Air Force Systems Command's System Program Office (SPO), he is responsible for organizing the AFLC logistic effort. From conception onward, AFLC specialists—under the system manager—serve as principal logistic advisors on new systems. They carry out preliminary logistic planning concurrently with planning for research, development and testing of a system. Working as an integral part of the SPO, they participate in all logistic planning, spelling out how the system will be supported during every phase of its life cycle.

During the updating and rewriting of specifications, AFLC system managers develop new criteria and requirements for contractor change proposals, prepare data for updating budgets and programming data, and assist in the technical evaluation of the system's components to insure operational supportability, maintainability and reliability.

Thus, the system manager must essentially be an experienced and competent organizer, manager and integrator, fitting all of the complex parts of the logistic system together. His objective—and his prime responsibility—is to fit them together on a timely basis in a coordinated effort to meet the requirements of his customer—the using command.

The AFLC system manager is not

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bound by arbitrary limitations on the scope of his activities. He is expected to move aggressively into any area involving his system. In dealing with other Air Force activities, other agencies and contractors, he speaks with the authority of the AFLC commander.

His responsibility ends only when the Air Force no longer has logistic responsibility for the system.

Choosing Systems for Logistic Management

Which systems will call for designation of an AFLC system manager? Primary considerations for determining this decision center around program cost, inventory size, configuration complexity, program duration, and priority and precedence.

But these are only the general guidelines which have been established for determining which system, project, or end item should have the special attention of a system manager. Weighting factors or special formulas for comparing one system against another have not been developed; nor is such action desirable. Each system, subsystem, project and item must be evaluated in relation to its own complexity and criticality, and not in relation to another program or project.

The need for special management attention is obviously greater at the system level because of the degree and magnitude of management integrated functions.

For example, AFLC system manager procedures apply to aeronautical systems, missile and space systems, and communications and electronic systems. Each is individually evaluated to determine the justification for an AFLC system manager and the organizational level of assignment.

Complete systems usually are assigned at division organizational level with one of AFLC's five air material areas (AMAs).

A number of subsystems are also assigned system managers. These include propulsion subsystems, electronic warfare subsystems, avionic subsystems, and reconnaissance subsystems. Criteria used in this determination are patterned after the criteria for complete systems.

In the final analysis, sound judgment, program familiarity and knowledge of problems are probably the best criteria. The final decision as to which system, subsystem, project, or item requires the assignment of an AFLC system manager is delegated to the AMA commander to whom complete logistic responsibility has been assigned.

System Manager Assigned Early

Recently, AFLC Commander General Jack G. Merrell established a policy of early assignment of system managers. Assigning a system to an AMA as early as possible, General Merrell points out, ". . . provide[s] the opportunity for AMA logisticians to influence design and development of the hardware and to acquire the required capability to support the system throughout its operational life."

Accordingly, the early assignment of system manager responsibilities has also become a prime AFLC policy. Assignments are made concurrently with the establishment of the SPO and are essential to assure effective participation by AMA-level logisticians in the decision-making processes which occur during the very early phases of the system.

Integrated logistic support planning and management requires a dynamic working relationship between the acquisition managers and the AMA logisticians. The early recognition of AMA responsibilities is fundamental to the success of the AFLC system manager program.

Army Announces New R & D Labs at Belvoir

The U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., has announced the establishment of a new laboratory and the upgrading of a former division to laboratory status.

The Advanced Systems Laboratory was established to provide the center capability of using modern analytical methods to determine the best ways of mixing hardware, utilizing existing and future devices for most efficiency, and gaining greatest use from any given research and development effort.

The status change involved the former Electromagnetic Effects Division of the Electrotechnology Laboratory, which will now be known as the Electromagnetic Effects Laboratory. The new laboratory is the Army's leading agency in the electromagnetic pulse (EMP) nuclear weapons effect field. It is responsible for theoretical and experimental applied research on EMP effects, and applications of research results for the protection of Army materiel.

Major Thomas H. Huber, former Acting Deputy Commander of the Research and Development Center, has been named to head the Advanced Systems Laboratory. Donald B. Dinger, chief of the Electromagnetic Effects Division, remains head as it assumes status as a laboratory.

Tri-Service Office To Standardize Equipment for Fire Fighting

A tri-Service office for standardization of military airfield fire fighting equipment has been established at the Air Force System Command's Aeronautical Systems Division, Wright-Patterson AFB, Ohio.

The Fire Fighting and Crash Rescue Equipment Systems Program Office (SPO) was set up on the recommendation of a Defense Department study group which found a wide variety of equipment in use by the three Services and a lack of established studies on future equipment needs. The office will be headed by Lieutenant Colonel Robert B. Artz, USAF, with representatives of the Army, Navy and Air Force present.

In addition to developing and purchasing fire fighting and rescue hardware, the office will establish test and evaluation criteria for all such Defense Department equipment and standardize fire fighting techniques among the Services.

The office will also conduct investigations into flight hazard potential, operational environment, fire suppression and rescue capability, survival criteria and fire itself.

The SPO will have responsibility for procurement of the following equipment: vehicles, extinguishers and related fire extinguishing agents and dispensing equipment, fire prevention equipment (runway foam vehicles), ground rescue systems and related equipment, fire protective clothing, and mobile tactical systems for the U.S. Marine Corps.

Defense PPBS—A 1969 Overview

Cdr Steven Lazarus, USN

[Editor's Note: The following is adapted from an unpublished article by the author titled, "PPBS: Retrospect and Prospect." A diagram illustrating the Defense PPBS appears on pages 20 and 21 in this issue.]

In July 1965, *Fortune* magazine published an article on defense management which contained an illustration entitled, "Mr. Hitch's Marvelous Budget-Making Machine." Almost four years have passed since the appearance of this serpentine diagram, and a number of changes have taken place. It seems worthwhile to describe and illustrate the Defense Planning - Programming - Budgeting System (PPBS) as it exists in the spring of 1969, if only as a reference point against which to measure future change.

November to March

Late in the calendar year, while the budget analysts in the Office of the Secretary of Defense are grappling with the next fiscal year's budget, the Joint Staff of the Joint Chiefs of Staff is busy formulating the Joint Strategic Objectives Plan (JSOP). This planning effort involves the digestion of masses of intelligence data to arrive at an estimate of the capabilities and proclivities of potential enemies, and the assessment of the present capabilities of U.S. forces and weapons, as well as the technological advances expected shortly from the vast defense research establishment. The plan is a military judgment as to the forces and programs which should be supported the next five to eight years.

April to August

After the JSOP is formally presented early in March, a series of Draft Presidential Memoranda (DPMs) is prepared. The words "draft" and "presidential" are important. The memoranda are drafts because they are tentative and the guidance they contain is subject to considerable modification during the year. Indeed, in an earlier form, the documentation which appeared in the spring was called tentative force guidance. They are Presidential in the sense that they are advisory notifications to the President who can accept or reject them and, as such, they are privileged. They are actually summaries of conclusions drawn from special studies and analyses which also take place in the spring. They attempt to evaluate the major issues inherent in the JSOP and in the overall environment in order to establish priorities and determine the best, least-cost anwers to major questions of military necessity.

The DPMs and their non-force-oriented counterparts, the Draft Guidance Memoranda (DGMs), establish the frame of reference for programming in DOD. The Military Departments respond to these policies with Program Change Requests (PCRs), calculated to reshape their resource requirements in order to achieve the force capabilities stipulated in the DPMs. At this point (by submitting an alternative PCR) and at several other points in the annual decision-making flow, the Military Departments have an opportunity to appeal the policy decision. Critics who argue that PPBS in its DOD manifestation is unnecessarily repetitive forget that the successive iterations provide a reasonable degree of procedural and substantive due process for all parties.

The PCRs are analyzed and the Secretary of Defense renders a Program Change Decision (PCD) on each. PCRs and PCDs are highly formalized documents structured in terms which correspond to the Five-Year Defense Program (FYDP). Thus, when the Secretary of Defense signs a PCD, he is agreeing to, for example, an increase of $10 million in the operating costs associated with a particular program element for each of the next five years. The decision is converted to computer tape and the FYDP is updated shortly thereafter. Thus, the FYDP, as it exists in the tapes and memory banks of the OSD computers, is, with the exception of one major period, always up to date.

Theoretically the special study—DPM-PCR-PCD flow—is concluded in early August (actually there has always been slippage) and an FYDP, up to date as of August 31, is available as a departure point for the formulation of the next year's budget. The term "departure point" rather than "ceiling" is used because guidance concerning the budget submission always provides for inclusion of items outside the approved program. These, however, are usually identified separately, segregated from the primary budget submission, and designated as "addendum." The basic budget is generally an expression of the near-term year of the updated FYDP.

October to December

Budget analysis in an important sense is the final scrub of the first program year. Admittedly, there are those who are discomforted when decisions are continually reopened for review, but shifting conditions are facts of life. Changing prices, economic escalation, technological breakthroughs, new threats, additional and more accurate information, fresh insights, all require that the DOD decision-making process remain dynamic. The budget analysis period is also the point at which the defense program impacts the national program, and it is reasonable to expect that neither will remain unmodified after such a collision. The demands of the congressional appropriation structure require that the program be translated back into input terms and this, too, is accomplished during the budget review.

During this period the budget estimates submitted by the Military Departments are exploded into analyzable pieces, each of which is evaluated and presented to the Secretary of Defense for decision. In 1967 and

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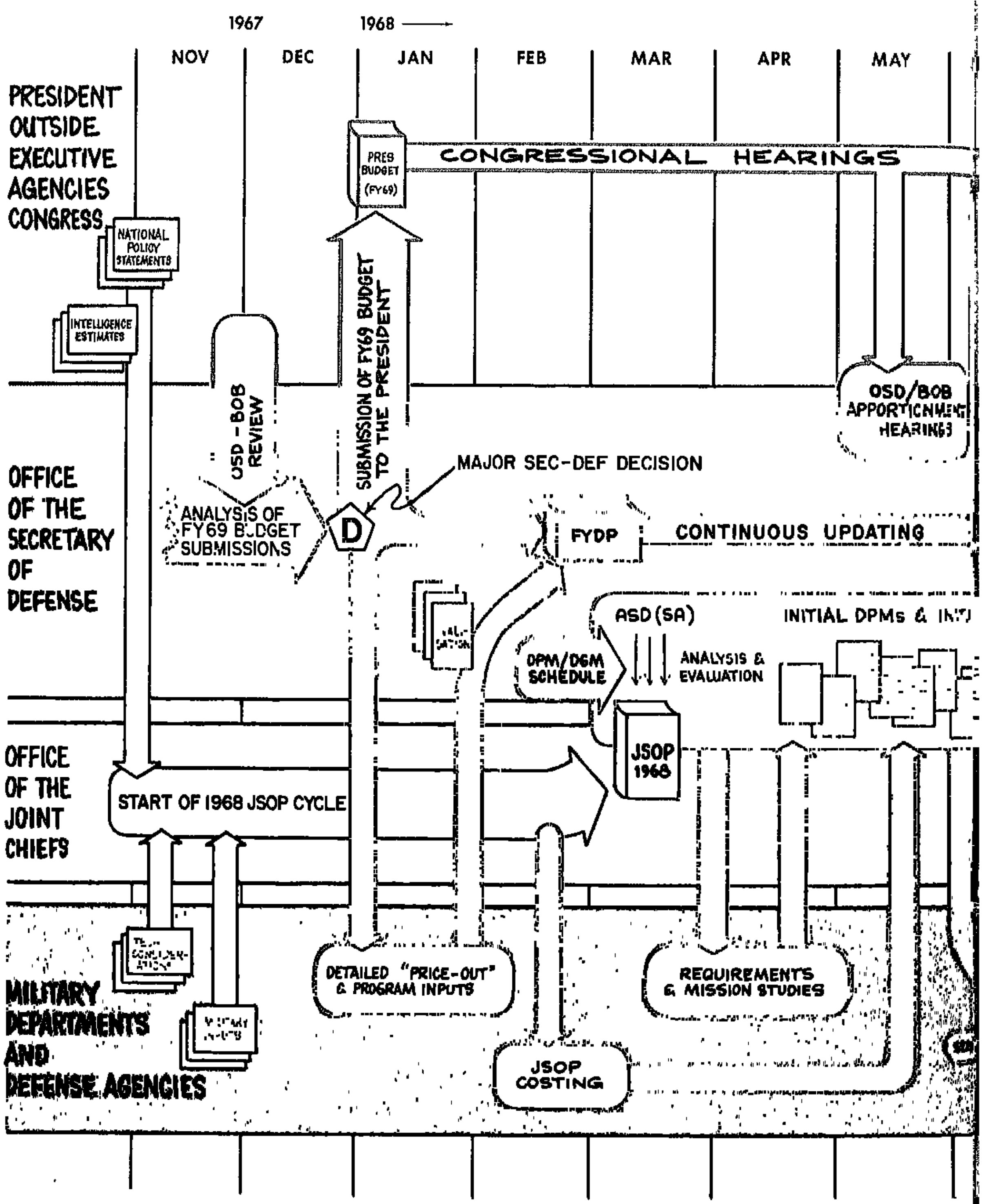
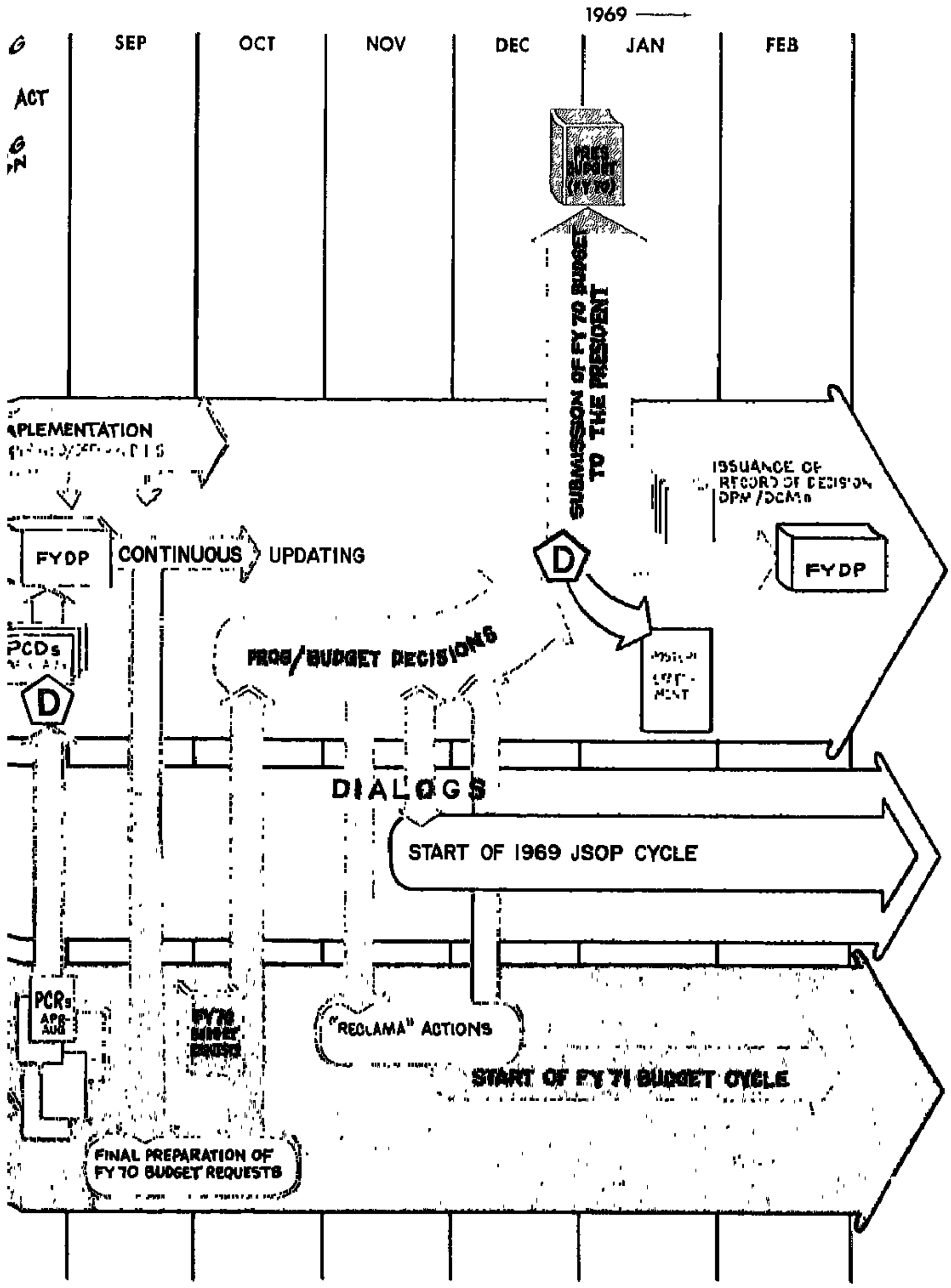
The PLANNING PROGRAMMI



DGETING SYSTEM



1968, the Secretary made 450 such program/budget decisions (PBDs). About 50 percent of these are the subjects of a reclama or appeal from the Military Departments involved, and about a quarter of these appeals result in changed decisions.

This appeal/review cycle is an indication of how priorities are established in the budget process. Actually the approved program sets the first priorities. The budget submission itself is usually divided into a basic and addendum budget. The basic budget is restricted to items included in the approved program, while the addendum budget includes additional requirements which have not been evaluated during the programming cycle, or have failed program approval. The reclama process is a form of appellate review and, since choices must be made in determining which items to reclama, this process tends to indicate priorities.

During the budget analysis period, the Military Departments and Defense Agencies have two formal opportunities and a host of informal oportunities to discuss critical decisions with the Secretary of Defense. Items selected for these discussions represent a structuring of priorities. The budget analysis period, thus, operates as a crucible continually precipitating out items, either through acceptance or rejection, and into which the more important of the rejected items are reintroduced until the residue becomes the most important of the remaining items in controversy. When resolved, the budget is complete (at least from the DOD standpoint).

The budget analysis period is an intensive look at resource allocation, but only in a two-year (current and budget year) time dimension. At this point PPBS is stood on its ear and the budget decisions are extended forward to reflect their five- and eight-year ramifications. This winter update of the FYDP is one of the weakest links in the programming chain for it is essentially a case of the two-year tail wagging the five-year dog. The update currently in progress has been to a degree facilitated by the availability of "Record of Decision" DPMs which presumably reflect the FY 1970 budget decisions, but the compressed time frame for the preparation of these DPMs and of the update itself operates to [illegible]

January to June

The Defense Department budget estimates are incorporated into the President's Budget and presented to the Congress in January. Throughout the spring and into the summer the Congress, particularly the two Appropriations and the two Armed Services Committees, holds hearings and takes testimony on the Defense Department portion. The House of Representatives and the Senate vote separately on the defense appropriations bills and the differences are normally resolved through conference committees. Conference committee bills also require the approval of both houses of Congress. This lengthy review and legislative process typically extends beyond the end of the fiscal year. The FY 1969 program was not appropriated until October 1968, four months into the fiscal year it was designed to finance.

The limitations of the calendar are circumvented in two ways. From July 1 until the passage of the bill, DOD operates on the basis of a "continuing resolution" passed by Congress for a stipulated period. The resolution provides for operation at the same rates and constrained by the same provision as existed the previous fiscal year. Secondly, even without a formally approved appropriations act, the Executive Branch *apportions* or distributes the anticipated appropriation in June. Apportionment, while formally understood as a distribution which provides the Executive Branch with a limiting or rate-setting mechanism, is also a second- or mid-term budget analysis during which any changes which have occurred in the intervening six months are recognized. Financial operating plans are presented by the Military Departments and Defense Agencies and it is at this time that the Secretary of Defense exercises his key legislative authority, as expressed in Title IV of the National Security Act, to approve obligation rates.

The Assistant Secretary of Defense (Comptroller) issues operating budgets covering the operations appropriations (operation and maintenance and military personnel), and maintains item control in the procurement area by means of an "approved/deferred list," and in the research and development area by means of a "research, development, test and evaluation program/fund authorization." Specific construction projects must be approved by the Assistant Secretary of Defense (Installations and Logistics), and approval for financing them is given by the Assistant Secretary of Defense (Comptroller). It is apparent that the Secretary of Defense retains careful and detailed control over resource allocation until the last possible moment.

Currently, the Assistant Secretaries of Defense (Comptroller) and (Systems Analysis) are actively working with the Service Secretaries to simplify and streamline the DOD decision-making process. A PPB Improvement Committee, composed of representatives of the Office of the Secretary of Defense and the Military Services, has produced 54 proposals for improvement, some of which are already being incorporated into the 1969 cycle. These include reduction of the number of DPMs/DGMs, simplification of cost detail requirements in PCRs, identification of specific PCRs required by DPMs/DGMs (an extension of the procedure used during 1968), and clarification of the relationship between specific DPMs and specific program elements.

Under serious consideration for the 1970 cycle is the publication, in late winter-early spring, of two major Draft Presidential Memoranda on Strategic Forces and General Purpose Forces which would serve as an integrating framework for all subsequent program memoranda, and would provide general guidance on anticipated level of investment by mission. A study is under way to determine the feasibility of examining the budget in five-year terms.

A decision-making process cannot be set in concrete. It must remain dynamic and susceptible to change if it is to retain its utility. As the parties to it gain more experience with it, improvement becomes obvious and necessary. Change can be aggravating, but obsolescence is a far greater danger. Organizations, like organisms, must adapt or they become anachronistic, atrophy, and eventually disappear. While Planning-Programming-Budget Systems as we know them today (and as we knew their predecessor systems 10 years ago) may not be the ultimate answer, they appear to be useful and adaptable. They are worthy of study and thoughtful consideration.

Management of Research and Development in an Air Force Laboratory

Colonel George A. Zahn, USAF

In an organization as large and complex as the Defense Department, planning for research and development is a difficult and complicated process. It involves short-range goals to meet critical needs of the operational units; medium-range goals to provide new capabilities afforded by expanding technology; and long-range goals to insure a continuing flow of new technology into the mainstream. Planning must consider the unique requirements of the Army, Navy and Air Force; yet it must insure an integrated defense posture which, hopefully, will deter warfare but, if unsuccessful in this pursuit, will win any conflict in which the United States engages.

Dr. John S. Foster Jr., Director of Defense Research and Engineering, has stated:

> Today, the survival of every nation and the life of every man on earth is touched by powerful new strategic weapons and the changing military capabilities of the major powers. These capabilities, in turn, are increasingly dependent upon advanced technology. The job of military research and development is to preserve our margin of safety—some choose to call it a margin of superiority—to deter war, and to make us able to respond decisively should war occur. Military research and development is the leading edge of our national security and provides new opportunities to increase the effectiveness of our Armed Forces.

With respect to planning and management, Dr. Foster goes on to say:

> In one sense, our research and development strategy is similar to that of other management groups. For a relatively few (roughly 100), large or particularly important programs (tens of millions of dollars), we can and must manage in detail. Some examples of these programs are the Sentinel ballistic missile defense, new aircraft (such as the anti-submarine VSX), new missiles (such as the Poseidon), and space efforts (such as the Manned Orbiting Laboratory). On the other hand, for the very large number (tens of thousands) of smaller projects, we attempt to set only broad priorities. This involves examining clusters of projects in terms of the traditional academic disciplines and in terms of technological or functional areas such as electronic countermeasures. Once broad priorities are established, most of the management of smaller programs is performed by the military departments.

General James Ferguson, Commander of the Air Force Systems Command, is responsible for the research and development effort within the Air Force. He points out:

> There is no perfect management system universally applicable to every set of circumstances. Just as the pace of technological advance has accelerated in recent years, there has been a commensurate expansion in the range of management options. Today there are more numerous tools, techniques, functions and organizations; each may be well suited to one case, yet none can be applied to every situation.
>
> Traditionally, the mission of research and development has been futuristic. It still is. But the future is any point ahead of us in time. It can be 10 seconds, 10 minutes, or 10 years away.

With regard to what he terms "our responsibilities for responsiveness," General Ferguson referred as follows to a three-pronged concept which he has advocated strongly since taking over command:

> The necessary facets are *professional management*, or the ability to adjust to the changing defense environment; *operational responsiveness*, or the application of talents and technology to operational capabilities; and *development planning*, the capability to formulate realistic proposals that can compete favorably for approval and funding of future weapon systems.

The Rome Air Development Center (RADC) is one of the Air Force

Colonel George A. Zahn, USAF, is Commander of the Rome Air Development Center, Griffiss AFB, N. Y. In prior assignments, he has served as Deputy for Communications Systems with the Electronic Systems Division of the Air Force Systems Command; and organized and commanded the first Defense Communications Agency organization in the European area. Colonel Zahn holds a bachelor's degree in electrical engineering from the University of Dayton.

laboratories upon which General Ferguson relies in providing new technology. It is one of the nine laboratories reporting the Director of Laboratories (DOL) within the Air Force Systems Command (AFSC). Located at Griffiss AFB in Rome, N. Y., RADC is assigned the technical mission for development in ground-based electronics and electromagnetics. This includes the full spectrum of activities ranging from exploratory and advanced development through operational and system support in these disciplines.

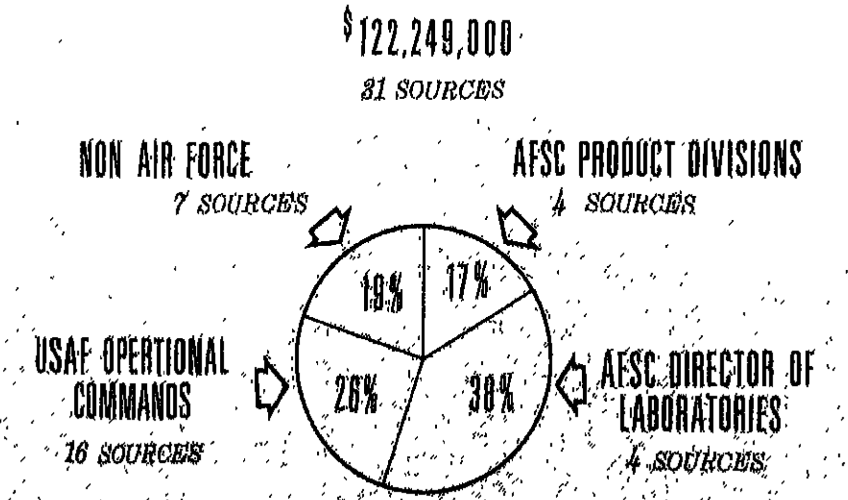
The broad scope of this activity, combined with extensive in-house development, provides experience, background and competence to fulfill the three functions of professional management, development planning, and operational responsiveness. Two examples of the laboratory's role in all three functions may be cited.

The first is RADC pioneering in the development of phased arrays starting in the early 1950s. Predicted vehicle speeds and target density indicated at that time that conventional radars, using mechanical motion for beam scanning, could not fulfill many future operational needs. Some earlier exploratory development in step-scan techniques and in high-power klystrons for master oscillator-power amplifier transmitters provided a starting point for the phased array concept. Internal laboratory planning and management initiated exploratory development on antenna elements, cross coupling, phase control techniques, and an experimental 10-by-10 element array.

By the late 1950s, the reality of space surveillance needs caused increased emphasis. DOD/Advanced Research Projects Agency support in the early 1960s resulted in an experimental Electronically Steerable Array Radar (ESAR). Later, in conjunction with the Electronic Systems Division of AFSC, RADC provided the engineering and contract control for an operational Space Surveillance Radar, the AN/FPS-85, located at Eglin AFB, Fla. This series of efforts, over a period of 15 years, required a coordination of the work of hundreds of scientists and engineers in industry and universities, as well as in government laboratories. Close to $100 million have been expended in this technological development, primarily with industry. Due to its inherent flexibility, the phased array approach is now a strong contender for other uses, such as smaller tac[illegible] cal type equipment and for airbor[illegible] applications.

The second example is RADC's r[illegible] liability techniques program datir[illegible] from 1956. It was realized then th[illegible] the reliability problems faced by t[illegible] Air Force could be solved only wi[illegible] a well planned, continuing progra[illegible] that would keep pace with the e[illegible] panding demands on system perform[illegible] ance. The general philosophy of t[illegible] RADC program was, and still i[illegible] that reliability must be inherent [illegible] the equipment design. Post-producti[illegible] and field-use fixes cannot significant[illegible] improve a design that has poor r[illegible] liability. Reliability must be co[illegible] sidered as a design criterion alo[illegible] with the usual performance par[illegible] meters. The RADC program in r[illegible] liability prediction addressed itse[illegible] to this objective through the develo[illegible] ment of techniques that would allo[illegible] a designer to quantitatively predi[illegible] the reliability of his product, a[illegible] to assess the effects of factors su[illegible] as design approach, parts deratin[illegible] parts procurement practices, and u[illegible] environment.

In recognition of these problem[illegible] RADC initiated a "Physics [illegible] Failure" program early in 1961. T[illegible]



Source of RADC funds-FY 68

general objective of the program was to relate fundamental change processes that take place in electronic materials at the atomic and molecular level to changes in electrical characteristics of a device. This information could then be applied to the improvement and assessment of reliability in electronic equipments.

This program has been implemented through a combination of in-house and contractual studies, designed to furnish a much needed physical basis for the statistical methods commonly used in reliability engineering. This approach has been accepted widely, as evidenced by the increasing number of reliability physics groups, similar to RADC's, which have been formed by both vendors and users, particularly in the solid state industry.

The experience and capability developed in the RADC reliability program led AFSC headquarters to request RADC to develop and establish, at Griffiss AFB, a Reliability Analysis Center (RAC) to serve as the Air Force focal point for the acquisition, storage, reduction, analysis, and dissemination of reliability experience data. RAC's present scope is microelectronics and semiconductor devices. Plans have been formed to increase the scope to electronic and electromechanical devices.

Major Areas of RADC Mission

In order to place RADC's research and development activity in proper context, a description of its laboratory, its resources, and its mission is necessary. Over 1,500 civilian and military people are employed at RADC, about half of whom are scientists or engineers. Office and laboratory space occupies one million square feet and, in addition, there are 16 off-base sites for experimental purposes. The Flight Test Division has 11 aircraft, all instrumented with unique equipment for performing a wide variety of experimental electronic and electromagnetic measurements. RADC funds, which normally exceed $120 million annually, come from 31 different customers.

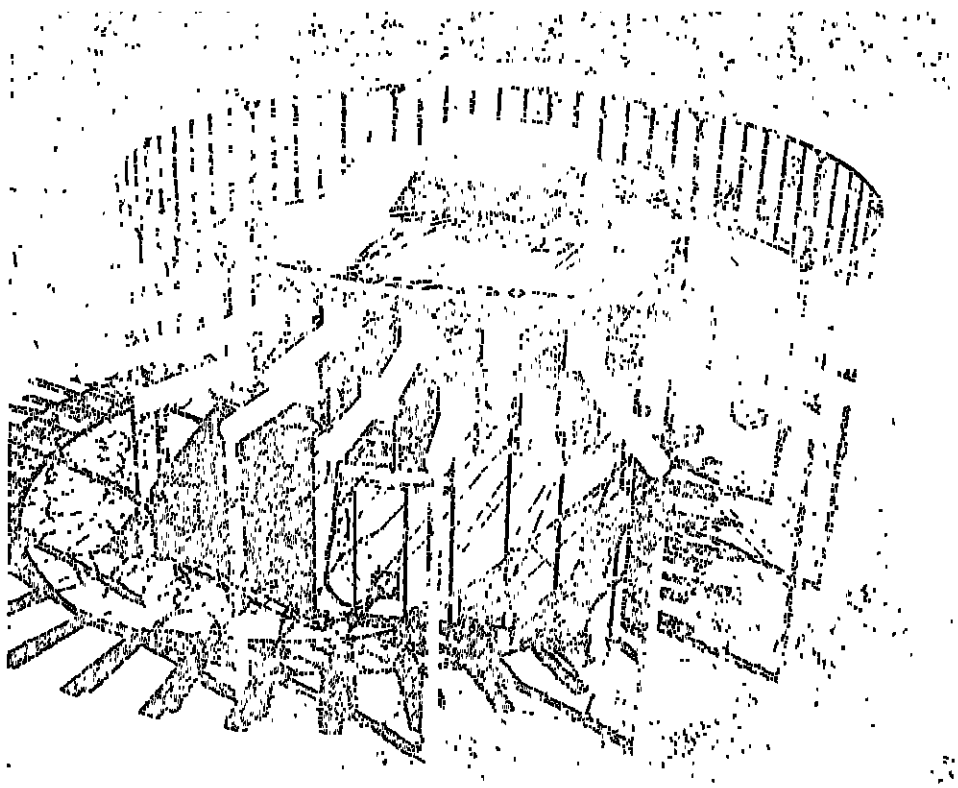
There are well defined areas in the assigned technical mission of RADC in ground-based electronics and electromagnetics:

- **Data or Information Acquisition.**

Both active and passive techniques and components must be considered. Consequently, our mission includes the development of radar techniques and components, such as antennas; transmitters; receivers; signal-processing, transmission-line, and pulse-compression equipments and phased arrays. Passive techniques include wide-band antennas for signal receiving and direction finding, goniometers, wide-band scanning receivers, and signal-processing devices.

- **Data or Information Transmission.**

Communications is the "name of this game" and it is very important in both strategic and tactical environments. Data or information is usually required at a place other than its point of acquisition. Thus, techniques must be developed for transmitting increasingly large amounts of data from one point to another—and in space application over vast distances. This may be accomplished by wire, radio, tropospheric or ionospheric scatter, or satellite, using analogue or digital procedures, voice or message, or by any combination of these. Antennas, switches, transmitters, modulators, demodulators, multiplexers, receivers, wide-band components, coders, and error-detection and correction devices, all must be developed to handle the ever increasing amounts of data.



An array and goniometer field installation for passive acquisition of electromagnetic information.

- **Data or Information Processing.**

An immense amount of data is acquired by our reconnaissance and intelligence systems and aerospace defense radars, collected on various communications networks, and delivered to our command and control systems. This data must be analyzed so that the intelligence in the information can be extracted and made meaningful to a user. RADC is involved in many types of data processing, and in the applications of data processing techniques to specific Air Force problems.

- **Automatic Language Translation**

In addition to the operational type data enumerated, technical publications contain numerous articles in various languages. Translation of this information is essential and presents an increasingly significant task which we desire to perform automatically to the greatest extent possible. Therefore, we have a program to develop data processing techniques for automatic language translation, including the input and output devices as well

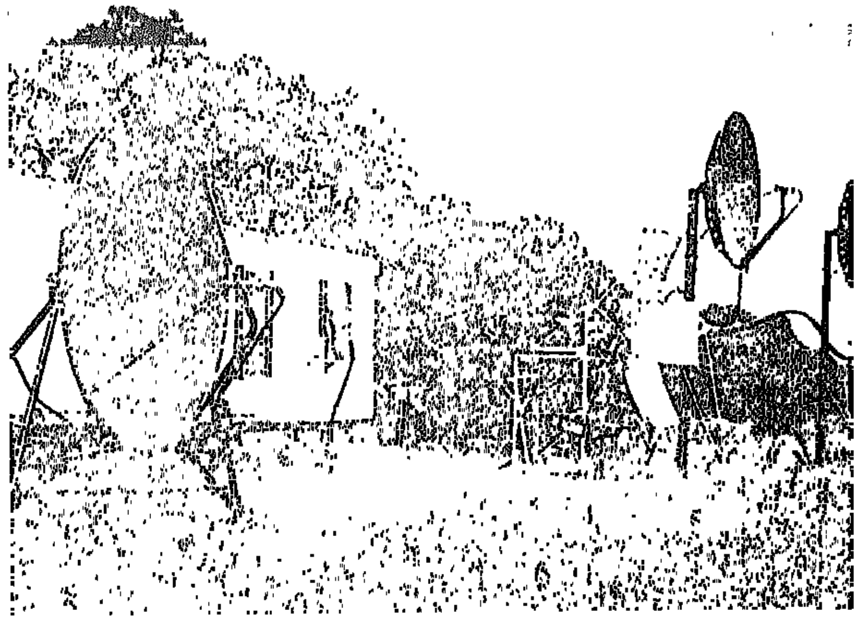
as the main frame memory systems and actual hardware. This is not just a simple dictionary-type lookup on a word-to-word basis. Rather, the sentences in one language format must be translated into meaningful, proper English grammar. Along the same lines, *i.e.*, handling of textual data, we are interested in evolving techniques for automatic abstracting, indexing and retrieval.

We also are involved in the automation of as much of the processing as is possible in the preparation of charts and other cartographic data. This includes photo interpretation and the automatic scanning of photographs, maps and charts to facilitate the extraction of intelligence from these materials.

- Display Techniques.

More and more the computer is becoming the heart of command and control systems, in communications, and in display devices. Thus, technology must be worked out for the interface between data processing and the other functions of command and control systems. Also, effort must go into the software and the peripheral equipments required for the proper utilization of data processing techniques in our Air Force environment.

We are concerned with the display subsystem—that part of the overall electronic system which finally presents the information to a decision maker. Here, we are involved in real-time display techniques to keep key people informed of changes as they occur. This requires a great deal of research and development on display devices, on new materials for electro-luminescent or bipolar crystals, on reusable film in cases where we cannot have real time, on multicolor displays, and on the various human engineering factors involved in making the display easily understood and assimilated by the viewer. One of the key problem areas in real-time display, at least for large-scale displays, is the cost-per-resolution element. This cost is very much affected by the brightness of the display element and by the switching circuits required for their activation. Millions of such elements will be needed in order to present the large-scale type of display now used, *e.g.*, Strategic Air Command headquarters, in presenting in multicolor air and missile fleet status information required by that headquarters. In almost all cases, that headquarters now uses a display system which in some manner employs the projection of film.



Lightweight troposcatter equipment, developed by RADC, undergoes tests at Eglin AFB, Fla.

In addition to the foregoing, there exists a requirement for research and development on the reliability of the electronic system components, and on electromagnetic compatibility between various elements and subsystems. If our equipments are to operate with a high degree effectiveness, they must not interfere with each other. We must devise methods for measuring interferences that might be expected in new equipments that are to be placed in operation. We must determine the extent of their vulnerability to other signals, and insure that electronic systems effectiveness is not reduced by excessive interference.

Management of Effort and Resources

All of the foregoing forms the major part of the mission at the Rome Air Development Center. Management's problem is to assure that a good balance is maintained between the amount of effort and the resources provided in each of the areas. We want to be sure that as technology within one area increases, its application will not be hindered by gaps in the technology of other areas. Maintenance of good balance of effort in all of these areas is essential.

Advances in the state of the art in technology are stimulated by two essentially independent processes. The first is natural curiosity and creativity in exploring unknown fields. Nuclear power, the laser, and solid state electronics are but a few of the breakthroughs in technology that have occurred recently. The second is responsiveness to stated problems and requirements. This second type of research and development, which generally leads to incremental improvements in the state of the art, is particularly important during periods of conflict such as that in Southeast Asia.

It is essential that a portion of our resources be reserved for research and development of the first type which leads to new technology —solutions looking for problems. Breakthroughs in the first category lead to an entirely new cycle in the second category.

In each category the preponderance of the ideas originate from within the laboratories, but the execution of these is controlled at higher echelons.

Based on its knowledge of technology and operational requirements, the Office of the Secretary of Defense (OSD) sets broad policy guidelines. Further, it exerts strong influence on the laboratory's program through the control of funds and facilities. The laboratory director also obtains guidance from the OSD level by observing the type of program that OSD manages in detail at its level. The selection of such programs is a good indication of DOD emphasis and priority.

Air Force headquarters uses OSD policy guidelines and information as bases for preparing its guidance for the Air Force Systems Command. This guidance comes generally in the form of the Planning Concepts Document and Program Change Proposals. Additional control of funds and resources is exercised at the Air Force headquarters level, always with the two-way communications, both up and down, necessary for good management.

The Air Force Systems Command controls its laboratories through the Director of Laboratories (DOL). Within the command are the systems divisions responsible for acquiring new operational systems, and the laboratories to provide new technology for the new systems. The DOL prepares the Long Range Plan which looks ahead 10 years and attempts to forecast the requirements for new technology and the approaches required for solving the problems. Technical Objective Documents (TODs), prepared by the laboratories, are published by the DOL. There are approximately 40 TODs covering major technological areas, and each TOD contains several specific technical objectives. Each of the technical objectives discusses the state of the art in the particular area, the areas which limit the state of the art, and possible approaches which might advance the state of the art. These TODs serve two important functions. First, they require the working-level scientists and engineers in the laboratory to assess their technology and forecast where that technology is heading. This can influence decisions at higher levels. Second, they are given wide distribution to industry where they can be used to set up corporate goals consistent with national goals. (See article, "U.S. Air Force Technical Objective Document Program," *Defense Industry Bulletin*, December 1968, page 14.)

The laboratory prepares its programs, utilizing to the best advantage the guidance it receives from its higher echelons. However, it does much more than this. It reacts constantly to the needs of the systems divisions of AFSC and of the operating commands. For example, the systems divisions prepare Technology Needs (TNs) with which they task the laboratories. These TNs describe operational deficiencies, limitations, blocks to improvement, or problems which have not been solved satisfactorily. The laboratory is expected to respond to these needs, either by identifying technology which will solve these problems, or by incorporating the requirement into its exploratory development program. The laboratory also works directly with the customer. For example, RADC works directly with the Aeronautical Chart and Information Center in the development of automatic cartographic capabilities. Similarly, we work directly with the Seventh Air Force in Southeast Asia, implementing the latest reconnaissance interpretation techniques.

The laboratory works directly with industry and universities, discussing requirements and ideas for new technology or applications of new technology. This technical exchange takes place through formal procedures, such as Technology Reviews, Independent Research and Development Program Reviews, etc., and through informal discussions between engineers and scientists in the laboratory or at symposia. Industry responds with unsolicited proposals based on knowledge of Air Force requirements. RADC accepted 44 out of 256 unsolicited proposals last year, or about one out of every six received.

Finally, the laboratory prepares its technical program plan for the following two fiscal years. This plan is composed of hundreds of individual line items (at RADC this involved about 1,500 specific efforts) which are grouped into the various project areas assigned to the laboratory. These represent the best technical judgment of the laboratory. On the basis of this plan, contracts are negotiated with industry and universities; and in-house work is initiated to provide a solid research and development program.

To be successful, the laboratory research and development program must be dynamic. It must contain all of the new pertinent technology and reach out as far as possible. It must not be satisfied with only small increments of improvement or change.

The program must be flexible. It must be capable of making room for new ideas that are generated. As priorities change or new requirements arise, it must be willing to bury old horses and place bets on the new ones.

The program must be responsive. This is particularly true in times of conflict when the lives of men may very well depend upon the laboratory output.

The program must be updated continuously to provide the best possible balance considering the need for new technology, the applications of technology to operational requirements, and the constraints of money and manpower.

Navy To Retire 19 Ships

The Navy has announced the names of 19 ships to be retired and five to be transferred to reserve status as part of the FY 1970 fleet cutback. The action is aimed at meeting a budget reduction of $26 million.

The ships to retired are the USS Irex (SS-482), USS Waller (DD-466), USS Taylor (DD-468), USS Walker (DD-517), USS Jenkins (DD-447), USS Fletcher (DD-445), USS Black (DD-666), USS Marshall (DD-676), USS Vammen (DE-644), USS March (DE-699), USS Whitehurst (DE-634), USS Falgout (DER-324), USS Vance (DER-387), USS Haverfield (DER-393), USS Wilhoite (DER-397), USS Aludra (AF-55), USS Shasta (AE-6) and an unnamed diesel submarine.

The five ships to be transferred to Naval Reserve training status are the destroyers USS Huntington (DD-781), USS Maddox (DD-731), USS S. Moore (DD-747), USS H.E. Hubbard (DD-748) and USS Brush (DD-745).

Also part of the FY 1970 reduction is the temporary inactivation of Patrol Squadron 7, based at Jacksonville, Fla. The squadron will be placed in a stand-down status pending transition from P-2 to P-3 aircraft, scheduled for about April 1970.

DOD Administration of Military Assistance Program and Foreign Military Sales

Address by Lt. Gen. Robert H. Warren, USAF, Dep. Asst. Secretary of Defense (Military Assistance & Sales), Office of Asst. Secretary of Defense (International Security Affairs), at the Aerospace Industries Association of America International Committee Meeting, Washington, D. C., March 26, 1969.

I am pleased to participate in this Aerospace Industries Association meeting. I am aware of the importance and effectiveness of your activities in support of our national objectives, and particularly their contributions to our Military Assistance Program (MAP) and Foreign Military Sales (FMS).

These are my subjects today. I wish they were new and fascinating. Unfortunately, they are complex and sometimes controversial. Both involve many rather routine facts and figures. Military assistance and sales are, however, most important to our world-wide policy of collective security and, I hope, matters of interest to this important organization.

Today, I hope to bring you up to date on our current activities and look briefly into the future; and to comment on the presently on-going reorganization of military assistance grant aid and Foreign Military Sales operations in Office of the Secretary of Defense (OSD), possible policy changes, and the Military Assistance Program.

First, the OSD reorganization: Two separate major offices in OSD's International Security Affairs (ISA) have been responsible for foreign military sales (International Logistics Negotiations) and military assistance grant aid programs (Director of Military Assistance).

Effective 12 days ago, these functions were combined in a single new office under the Deputy Assistant Secretary for Military Assistance and Sales.

Military assistance and sales were, as I am sure you know, first authorized by the Mutual Defense Assistance Act of 1949. Ever since General Lemnitzer headed the original office of Military Assistance in the early 1950s, there has been an organizational unit in ISA charged with administering these programs for the Secretary of Defense. Both grant aid and sales assistance continued to be provided under the authority of the Foreign Assistance Act and predecessor mutual security legislation until enactment of the Foreign Military Sales Act of 1968.

Although still dependent on common legislation, grant aid and sales became separate administrative functions within ISA when the Office of International Logistics Negotiations was established five years ago under Henry Kuss, who has departed from government service. The very recent re-combining of these grant and sales functions in the new single office is a logical move for several good reasons:

Lt. Gen. Robert H. Warren, USAF

- The transition from grant aid to sales is well advanced. The curve of delivery on a sales basis crossed that of grant aid in 1962.
- The reduction in grant aid and the corresponding increase in sales will continue as our allies become more self-sufficient and better able financially, to support adequate military establishments.
- The severe pressure on our total national resources, stemming from the cost of the war in Southeast Asia and increasingly urgent domestic needs make it more essential that all foreign assistance activities be closely coordinated. Military assistance and sales and the several forms of economic aid as well, must all work together to promote the security and foreign policy objectives of the United States. Duplication, waste, or competition among them cannot be tolerated if increasingly limited appropriation for these related purposes are to make optimum contribution to attainment of those objectives.

Both MAP and FMS legislation includes numerous provisions and restrictions, designed to insure proper control of arms transfers and to make certain that they support national policy. Compliance with these requirements of the law, which I shall mention in greater detail subsequently will be facilitated by the combined administration of the two functions.

Twin Instruments of National Policy

The Military Assistance Progra[m] and Foreign Military Sales are tw[o] instruments of that national polic[y]. They complement each other as mea[ns] by which the United States support[s,] strengthens and participates in fr[ee] world collective security. Arms tran[s]fers represent a direct and significa[nt] contribution to the military postu[re] of allied and friendly nations a[nd] regional defense organizations wh[ich] is the substance of collective securi[ty]. The armed forces we thus help support represent an extension of o[ur] own defensive posture and a ma[jor] deterrent to Communist aggression.

U.S. commitment to the principle and practice of collective security is manifest in the bilateral and multilateral collective security arrangement we have entered into with 43 countries throughout the Free World since World War II. Our membership in NATO, SEATO, ANZUS and the Rio Pact and, although we are not a signatory, our participation in the military planning activities of CENTO, also signal to both our friends and our potential enemies our determination to prevent further Communist aggression in any area of the Free World.

Although both grant aid and sales are instrumental in the development and maintenance of a credible collective defense, the contribution of MAP deserves special mention because it was this program which first checked further Communist expansion in Europe, and then went on to provide other threatened countries and areas with the means to protect themselves. The magnitude and importance of that contribution is reflected in the fact that no MAP recipient has been brought under the control of the USSR or the Peoples Republic of China, and only one former grantee, Cuba, is now a Communist country. Military assistance has also been a key factor in our relationships with nations in which we have bases and installations essential to optimum deployment of our own forces in support of U.S. global strategy.

Scope of Program

These are just a few of the ways in which the Military Assistance Program has promoted the security and foreign policy of the United States for 20 years by its support of the free world common defense effort. That support has taken the form of more than $34 billion worth of military equipment and related training—and associated costs—provided to a total of 78 allied and friendly countries. The materiel furnished included: $7.3 billion in vehicles and weapons, $6.5 billion in aircraft, and $4.2 billion in ammunition. Consider what, in fact, this expenditure has purchased in the form of forward defense.

Today, of course, the program bears little resemblance in size and scope to our initial grant aid undertaking for which the Congress appropriated almost $6 billion in FY 1952—almost 16 times our $375 million budget request for FY 1970. Increasing selectivity is another index of change. The number of recipient countries has been reduced from 69 in FY 1963 to 48 in FY 1969—and of those 48, only 25 are receiving materiel. Five of them alone—the forward defense countries of Greece, Turkey, Iran, and the Republics of China and Korea—account for approximately three-quarters of the total current year (1969) program.

Perhaps the best measure of both past MAP accomplishments and the on-going mutually beneficial interaction of grant aid and foreign military sales is the steady shift from the former to the latter, as earlier recipients become able to purchase the military equipment necessary to replace or augment the materiel given them by the United States in earlier years. It is interesting to note, however, that total military exports, both grant aid and sales, have stayed relatively consistent during the last 16 years, and that this stability will probably continue.

Grant aid programs for western European NATO nations from 1950 through FY 1967 totalled $12.3 billion. Sales orders placed by the same nine nations since 1962 amount to $6.2 billion—almost half the grant aid total. And, since the termination of grant aid to Japan in 1966, annual average Japanese acquisition of U.S. military equipment through co-production, commercial import and foreign military sales is running about $100 million.

Turning now to foreign military sales world-wide, I want to begin by recapitulating a few figures which I believe are significant, both as a record of past performance and as an indication of things to come:

- The United States has taken foreign military sales orders totaling $11.5 billion during the seven years ending in June 1968.
- Our long-standing estimate that actual sales would approximate $1 to $1.5 billion a year has been realized. Recent annual order total has somewhat exceeded $1.5 billion.
- The fact that a very high percentage of total sales orders to date have been placed by developed countries shoots down the uninformed, but unhappily persistent, claim that military purchases are jeopardizing economic progress and fomenting arms races among underdeveloped nations. Actually, Europe accounts for 74 percent of all sales orders since 1962, while only 1 percent is attributable to Africa and 2 percent to Latin America.
- If the so-called "oil rich" countries are included in the category of developed and industrialized nations, only 9 percent of total orders during the past seven years have come from the less developed countries. On a year-to-year basis, however, the portion coming from less developed countries is slowly increasing as the transition from grant to sales continues.
- It is also interesting to note that of the $11.5 billion total I mentioned earlier, 28 percent represented orders handled directly by U.S. firms, 48 percent orders handled on a government-to-government basis, and 24 percent on a credit basis. The latter were divided about half and half between the Export-Import Bank and private banking on the one hand, and Defense Department credit on the other.
- Finally, during the past seven years, the cash receipts coming from foreign military sales have covered just short of 60 percent of foreign exchange costs associated with the overseas deployment of U.S. forces in all areas except Southeast Asia.

Operation Under 1968 Act

The current fiscal year is the first year of operation under the Foreign Military Sales Act of 1968. Although it provides for a number of specific controls to be exercised by the Congress, we have always applied certain major restraints on foreign military sales. It is generally required that the military equipment being sold meet a valid military need. The recent decision of the Federal Republic of Germany to procure the Phantom aircraft meets a military requirement which is almost as important to the United States as it is to Germany. Many military exports, however, involve more complex criteria. These are all closely associated with the support of U.S. foreign policy, but they include specific considerations related to U.S. security, probable impact on arms races, questions of releasability of classified information, an[illegible] tension of U.S. influence.

U.S. military export[illegible] good econ[illegible] sense. The

use of country resources, because they are designed to exert a restraining influence on the diversion of scarce resources to any military purchases for which there is no valid requirement. Financing sources and terms take into consideration both the ability of the country to pay and the ability of the United States to make credit available, on a basis which puts it to best use among many needs.

The typical potential sale involves all of these considerations and restraints and, often to the chagrin of international vice presidents of your member firms, many prospective sales end up on a "disapproved" list.

As I mentioned earlier, the Foreign Military Sales Act of 1968 contains a number of provisions which I believe are worth enumerating. This new separate sales legislation has:

- Abolished the so called "revolving fund"—establishing instead a requirement to obtain from the Congress each year such funds as are required to finance those military credit sales for which no other credit is available.
- Annulled the authority of the Defense Department to guarantee Export-Import Bank credit to the less developed countries.
- Placed a ceiling of $296 million on foreign military sales credit which may be extended during the current fiscal year. For FY 1970, we have proposed a credit sales program of $350 million based on a fund request for $275 million.
- Establishing new reporting requirements to the Congress covering past sales and estimates of future sales.

The Conte Amendment, paralleling a provision in the Foreign Assistance Act, restricts the sale of sophisticated weapons. It also adds the provision that no credit sales funds will be used to finance the sale of sophisticated weapons except for Greece, Turkey, Iran, Israel, the Philippines and the Republics of China and Korea unless the President finds such sale important to the security of the United States.

The Symington Amendment prohibits any sale to a less developed country which is diverting its own funds to excessive military expenditures, or diverting U.S. development assistance to any military expenditure.

The Ruess Amendment provides that there shall be no assistance given to countries whose military dictators deny social progress to their people.

Finally, the Pelly Amendment prohibits sales to a country which interferes with U.S. fishing vessels.

The Congress also established specific grant and foreign military sales ceilings for the FY 1969: $75 million for Latin America (excluding training) and $40 million for Africa (including training).

Administration of the Program

The new act also emphasized the responsibility of the Secretary of State to exercise supervision over U.S. military exports. While we have always operated in close coordination with and under the policy control of the Department of State, this emphasis in the act has led to a more comprehensive set of procedures to assure that there is absolutely no inadvertence in the management and control of foreign military sales.

The possibility of such inadvertence in administering either the Military Assistance Program or the Foreign Military Sales Program is minimized by a variety of other constraints and controls under which we operate. Each year's programs, including country sales estimates and MAP dollar ceilings for individual recipient countries, are subjected to extensive and repeated review and refinement throughout the Executive Branch before they are submitted to the Congress for legislative action. This is a never-ending cycle of considerable complexity.

To illustrate, let me trace just the major steps by which military assistance plans and programs, developed by the Military Assistance Advisory Groups (MAAGs) and Missions in the field, finally become deliveries of equipment and training. The review process begins with the Country Team and continues through the cognizant Unified Command to the Office of the Secretary of Defense, at which point the required coordination brings into the picture the Joint Chiefs of Staff, the Department of State and the Agency for International Development (AID), the Bureau of the Budget, the National Security Council—and, in some cases where Public Law 480 is involved, even the Department of Agriculture.

The final product of all this consultation and scrutiny is then reduced to writing in what we c Congressional Presentation Docume (CPD), which is submitted to fo committees of the Congress as nar tive and statistical documentation the President's annual budget reque for MAP. These four committees Senate Foreign Relations, House A fairs and the Foreign Operatio Subcommittees of the Senate a House Appropriations Committees hold often extensive and always pe trating hearings on our proposals a report their findings and recommen tions to their parent bodies. Floor bate, conference and final legislat action follow; but the cycle is complete, until the annual program adjusted to conform to the amo appropriated and any new restricti which may have been added duri the legislative process. The end res is, I can assure you, a carefully c trolled allocation of military assi ance which allows little latitude the sort of waste and mismanagem which critics of foreign aid delight ascribing to us.

Foreign Military Sales are also, I have indicated, subject to very st control and repeated review by ot elements of the Executive Branch the Congress. Then, there is alw the General Accounting Office wat ing over all our efforts in both grant and sales portions of our o ation.

One result of this continuing, c prehensive oversight of our activi is a substantial reduction in the n ber of personnel assigned to M and FMS duty with 45 MAAGs, sions, and five defense attac charged with responsibility for ministering military assistance grams and facilitating sales arra ments in their respective countries. We expect to reduce sonnel strength in these over elements of our operation by 2 before July 1970, leaving about 5 total world-wide. This reduction of course, have a favorable impac both our balance of payments a tight military budget.

I hope to use the talents and tacts of the remaining 5,000 to fullest possible extent in our For Military Sales activities, and I sider it important that your ove representatives work with or thr them and their offices whenever can.

(*Continued on Inside Back Cov*

MEETINGS AND SYMPOSIA

JUNE

Fifth Propulsion Joint Specialist Conference (classified), June 9–13, at Colorado Springs, Colo. Sponsor: American Institute of Aeronautics and Astronautics. Contact: Meetings Department, American Institute of Aeronautics and Astronautics, 1290 Sixth Ave., New York, N.Y. 10019.

Federal Research and Development in the 70s—Its Need and Scope Symposium, June 11–12, West Auditorium, Department of State, 23rd St. between C and D Sts., NW, Washington, D.C. Sponsor: National Security Industrial Association. Contact: National Security Industrial Association, Dept. RD, 1030 15th St., NW, Suite 800, Washington, D.C. 20005. Phone (202) 296-2266.

Microcirculation in Perfused and Transplanted Organs and Organ Systems Conference, June 16–17, at University of Miami, Miami, Fla. Sponsors: Office of Naval Research and University of Miami. Contact: Dr. Theodore I. Malinin, Biochemical Research Laboratory, American Foundation for Biological Research, 11125 Rockville Pike, Rockville, Md. 20852. Phone (301) 946-1250.

Parallel Processor Systems Symposium, June 25–27, at Naval Postgraduate School, Monterey, Calif. Sponsors: Naval Weapons Center, Navy Postgraduate School, Hobbs, Associates, Inc., and the Office of Naval Research. Contact: Joel Trimble, Office of Naval Research, Code 437, Washington, D.C. 20360. Phone (202) 696-5038.

JULY

Sixth International Physics of Electronics and Atomic Collision Conference, July 27-Aug. 2, Massachusetts Institute of Technology, Cambridge, Mass. Sponsors: Air Force Office of Scientific Research, Massachusetts Institute of Technology, Office of Naval Research, National Science Foundation, International Union of Pure and Applied Sciences, and the Army Research Office, Durham, N.C. Contact: D.W. Wennersten, Air Force Office of Scientific Research (SRPP), 1400 Wilson Blvd., Arlington, Va. 22209, phone (202) OXford 4-5454; or Dr. Robert Mace, Director, Physics Division, U.S. Army Research Office-Durham, Box CM, Duke Station, Durham, N.C. 27706. Phone (919) 286-2285.

AUGUST

Fifth Cryopreservation Conference, August 7–9, at Buffalo, N.Y. Sponsor: Office of Naval Research. Contact: Lt. Cmdr. Vernon P. Perry, MSC, USN, National Naval Medical Center, Bethesda, Md. 20014. Phone (301) 295-1123.

International Conference on Photoconductivity, August 12–15, at Department of Materials Science, Stanford University, Stanford, Calif. Sponsors: Physics Branch, Office of Naval Research and Department of Materials Science, Stanford University. Contact: Prof. R.H. Bube, Local Arrangements Chairman, Department of Materials Science, Stanford University, Stanford, Calif. 94305. Phone (415) 321-2300.

International Conference on Science of Superconductivity, Aug. 25–28, Stanford University, Stanford, Calif. Sponsor: Air Force Office of Scientific Research. Contact: Lt. Col. R.A. Houidobre, Air Force Office of Scientific Research (SRPS), 1400 Wilson Blvd., Arlington, Va. 22209, phone (202) OXford 4-5588; or Prof. W.M. Fairbank, Stanford University, W. W. Hanson Laboratory of Physics, Stanford, Calif. Phone (415) 327-7800.

SEPTEMBER

Fourth annual Society of Logistics Engineers Convention, Sept. 9–10, at the Cape Kennedy Hilton Hotel, Cape Canaveral, Fla. Sponsor: Society of Logistics Engineers. Contact: George Dill, Publicity Chairman, Public Relations, M.U. 517, Aerospace Services Division, Pan American World Airways, Inc., Patrick AFB, Fla. 32925. Phone (303) 494-4844.

Navigation and Positioning Symposium and Advanced Planning Briefing for Industry (classified), September 23–25, Fort Monmouth, N.J. Sponsors: Army Electronics Command, Institute of Navigation and the Army Aviation Association of America. Contact: Col. James L. Burke, Special Assistant for Aviation and Aviation Electronics, Army Electronics Command, Fort Monmouth, N.J. 07703.

NEREM—69 Calls for Technical Papers for November Meeting

The New England section of the Institute of Electrical and Electronics Engineers has issued an invitation for papers for the 22nd Annual Northeast Electronics Research and Engineering Meeting (NEREM) to be held in Boston, Mass., November 5–7.

NEREM-69 will consider two types of papers: first, technical papers in engineering, research, or development, focusing on new and original work; second, technical application papers covering the use of components, circuits, instruments and hardware in military, industrial, or commercial equipment. Authors wishing to check suitability of their subjects may call the NEREM office, (617) 527-6944.

The deadline for both the abstract and condensed versions of the papers has been set at July 1, 1969, by NEREM-69. The address for submissions is: Program Chairman, IEE NEREM-69, 31 Channing St., Newton, Mass. 02158.

For further information on NEREM-69 contact Val Laughner Associates, Inc., 581 Boylston St., Boston, Mass. 02116. Phone (617) 267-3800.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Gen. Andrew J. Goodpaster, USA, designated to succeed Gen. Lyman L. Lemnitzer, USA, as Comamnder-in-Chief, U. S. European Command, and Supreme Allied Commander, Europe, formally assumed command of the U. S. European Command on May 5. Gen. Lemnitzer will remain as Supreme Commander, Europe, until he retires on July 1, at which time General Goodpaster will assume that command.

Richard A. Ware has been selected as Principal Dep. Asst. Secretary of Defense (International Security Affairs), succeeding Ralph Earle II, who will become Defense Advisor, U.S. NATO, in Brussels, Belgium.

Joseph J. Liebling, Dir. of Security Policy, Office of Asst. Secretary of Defense (Administration), is one of 10 recipients of the 1969 Career Service Award given by the National Civil Service League. The award recognizes Liebling's unique expertise in the security policy area. In his position, he serves as principal advisor to the Asst. Secretary for Administration with responsibility for policy planning, program guidance, and executive direction of security programs for both DOD organizations and defense contractors.

Brig. Gen. Henry J. Stehling, USAF, has been assigned as Dir., Real Property Maintenance Directorate, Office of Asst. Secretary of Defense, (Installations & Logistics).

Col. Daniel H. Callahan, USAF, (Brig. Gen. selectee), is the new Dir. of Production, Defense Contract Administration Services Region, Defense Supply Agency, O'Hare International Airport, Chicago, Ill.

Col. Benjamin W. Eakins, USAF, (Brig. Gen. selectee), has been named Chief, Financial Services Div., Contract Administration Directorate, Defense Contract Administrative Services, Defense Supply Agency, Cameron Station, Va.

Col. Willis M. Lake, USAF, (Brig. Gen. selectee), has been assigned Dir., Quality Assurance, Defense Contract Administration Service Region, Defense Supply Agency, Federal Office Building, Cleveland, Ohio.

Col. George L. Dalfries Jr., USAF, is the new Dep. Dir., Office of Legislative Affairs, Office of the Secretary of Defense.

Col. Robert E. Hamel, USAF, has been assigned as Dep. Project Manager, SATCOM Program Management, Defense Communications Agency.

Col. Robert R. Lochry, USAF, is Staff Officer, Office of Asst. Dir. (Space Technology), Office of the Dir. of Defense Research and Engineering.

Capt. William O. McLean, USN, has been assigned as Chairman, Joint Chiefs of Staff Special Study Group, Washington, D.C.

Capt. Gilbert S. Young, SC, USN, is the new Commander, Defense Contract Administration Services Region, Defense Supply Agency, Atlanta, Ga.

DEPARTMENT OF THE ARMY

Maj. Gen. Frederick J. Clarke has been nominated for lieutenant general to replace Lt. Gen. William F. Cassidy as Chief of Engineers. Maj. Gen. Clarke has been Dep. Chief of Engineers. Lt. Gen. Cassidy is retiring from active service.

The new Director of Maintenance at Headquarters, Army Materiel Command, Washington, D. C., is Brig. Gen. Arthur W. Kogstad.

Maj. Gen. Henry A. Rasmussen has been named Commanding General, U.S. Army Weapons Command, Rock Island, Ill. He replaces Maj. Gen. O. E. Hurlbut who was appointed as Army member of the Joint Chiefs of Staff Logistic Review Board.

Dr. William L. Archer has been appointed scientific advisor to the Institute of Land Combat, Fort Belvoir, Va. He is the former Dir., Combat Operations Research Group.

The U.S. Army Aviation Test Board has a new president, Col. Daniel G. Gust, who stepped up from deputy president.

Col. Joseph E. Halloran Jr., has been named Comptroller/Program Coordinator for the U.S. Army Combat Developments Command, Fort Belvoir, Va.

Col. Howard C. Metzler has taken command of the U.S. Army Aberdeen, Md., Research and Development Center.

DEPARTMENT OF THE NAVY

Capt. Douglas G. Aitken, SC, has been named Dep. Commander for Purchasing, Naval Supply System Command Headquarters, Washington, D.C.

Capt. Richeard J. Licko has been assigned to the Defense Weapon Systems Management Center, Wright-Patterson AFB, Ohio, as Asst. Dean.

DEPARTMENT OF THE AIR FORCE

Lt. Gen. Robert N. Smith replaces Lt. Gen. Robert J. Friedman as Chief of Staff, United Nations Command, Korea, and Chief of Staff, United States Forces, Korea. Lt. Gen. Friedman is now Vice Commander, Air Force Logistics Command, Wright-Patterson AFB, Ohio.

Maj. Gen. Pete C. Sianis is the new Dep. Chief of Staff, Materiel, for the Strategic Air Command, Offutt AFB, Neb.

Brig. Gen. Harmon E. Burns has moved from Asst. Dep. to Dep. Chief of Staff, Materiel, Air Training Command, Randolph AFB, Tex.

Col. Vernon R. Turner, Commander, Air Force Data Systems Design Center, Bolling AFB, Washington, D.C., has been appointed brigadier general.

Col. Thomas J. Cecil has been named Dir. of Systems Test, Air Force Flight Test Center, Edwards AFB, Calif.

Col. William R. Coleman has been assigned as A–7 systems support manager, Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla.

Col. Robert P. Fuqua has reported as Mission Dir., Test Operations, Space and Missiles Systems Office, (AFSC), Los Angeles, Calif.

Managing the Air Force's Ground Electronics Program

Brigadier General Franklin A. Nichols, USAF

Today's military environment, with its many faceted uses of global communications, has made the traditional concept of military communications as outdated as the carrier pigeon and the mule-drawn caisson.

This is particularly true of the Air Force. No longer can a "Wing and a Prayer" be the byword. Command control has taken its place.

Only through the use of precise, reliable electronics is command and control possible. It is not that the computer and the scanner have taken over—they are simply a necessary adjunct to the men and women who carry out the increasingly complex mission of the Air Force.

This burgeoning future of communications-electronics-meteorological (CEM) requirements was recognized by the Air Force in the late 1950s, when it created the Ground Electronics Engineering Installation Agency (GEEIA). The engineering and installation capabilities of 27 organizations in 7 different commands were consolidated to form the agency, and it became a part of the Air Force Logistics Command (AFLC). AFLC added on-site depot level maintenance responsibilities to GEEIA's mission in 1964.

The current Air Force inventory of about $8 billion worth of fixed ground CEM equipment, with an add-on of more than $500 million annually, testifies to the wisdom of the decision to establish GEEIA.

Within the organizational structure of AFLC, GEEIA has the same status as AFLC's air materiel areas (AMAs). It is headquartered at Griffiss AFB, N. Y., and has a global operating responsibility made up of 5 regions and 16 squadrons strategically deployed throughout the Free World. Nineteen Air National Guard squadrons, with some 3,400 men, also are assigned for mobilization and training.

GEEIA's customers include each major air command, separate operating agency and Air Force installation. At any given time, the engineers or their installation and mobile maintenance teammates are at work at any one of over 400 sites around the world.

GEEIA Management System

By necessity, management must be the first order of importance. A system known as the GEEIA Management System (GEMS) reflects every job that GEEIA is currently working on or has programmed, providing computerized information tailored to the agency's specific needs. This includes data from the outset of the requirement to the wrap-up of the physical installation, and any necessary follow-on depot level maintenance.

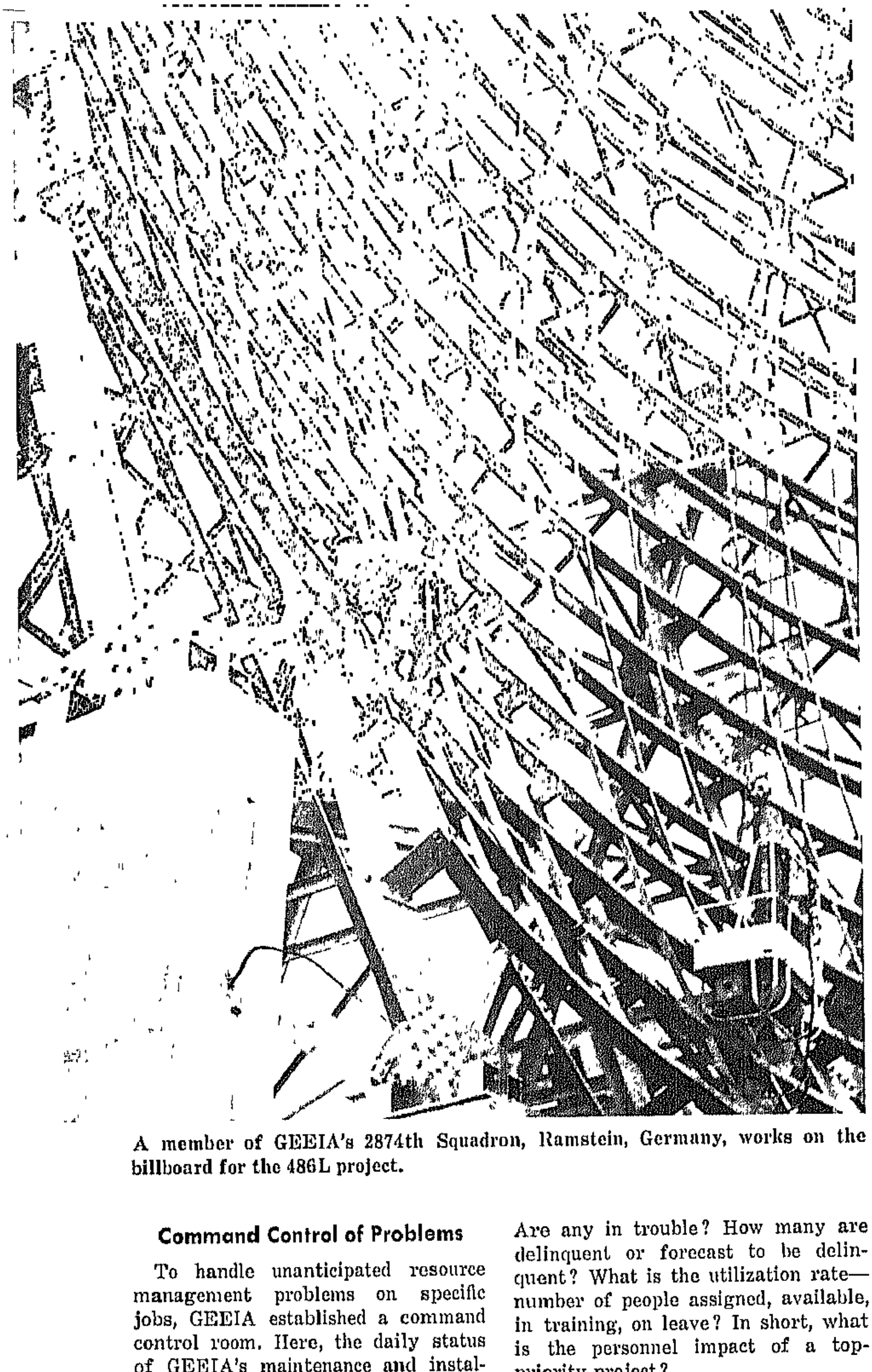
GEMS contains separate subsystems which handle the requirements of each management area. Data from each subsystem feed into a common data storage bank which produces composite reports that portray the total picture of resource requirements and utilization, plus the current status of workload. This system is continually reworked, revitalized and updated.

Data obtained from GEMS are analyzed and evaluated. Results of each preceding month's operation are presented to the commander and appropriate staff officers in the form of a monthly management review. Each region's performance is compared with its sister regions and with established standards for each topic. Subjects evaluated range from administrative support areas, upgrading on-the-job training, job order status and completions to specific world-wide problems.

This GEMS data and monthly management review are published as the "Management Analysis Digest," a composite, easy-to-handle document that each commander and staff member can refer to at all times.

The performance yardsticks include such broad areas as mission operations (CEM support in terms of engineering-installation and mobile depot maintenance accomplishments); number of jobs, slippages in Facility Support Dates (FSD), delinquencies in FSD's plant-in-place records; safety; training; finance; administration and on-the-job training.

Brigadier General Franklin A. Nichols, USAF, is Commander of the Air Force's Ground Electronics Engineering Installation Agency. Prior to assuming this command, he served as Chief of Staff, Seventh Air Force, in Vietnam; and before that commanded the 833rd Air Division. General Nichols is a graduate of Washington and Lee University, and also has attended the Armed Forces Staff College, Naval War College, and completed Parachute Jump Training at Fort Benning, Ga.



A member of GEEIA's 2874th Squadron, Ramstein, Germany, works on the billboard for the 486L project.

Command Control of Problems

To handle unanticipated resource management problems on specific jobs, GEEIA established a command control room. Here, the daily status of GEEIA's maintenance and installation workload and work force is maintained.

The information from the computer is manually displayed with daily updating. Where are the teams? What are the compositions, both numbers and skill-wise? What are their problems? How can GEEIA headquarters assist the region or squadron?

Each region is shown as a whole. How many jobs is it working on? Are any in trouble? How many are delinquent or forecast to be delinquent? What is the utilization rate—number of people assigned, available, in training, on leave? In short, what is the personnel impact of a top-priority project?

With one region reviewed daily, the entire organization is covered on a weekly basis. Each effort is reviewed from all angles. Is material needed? Is the allied construction at fault? Are additional personnel from other regions needed to augment the basic team? Is a multiple shift operation required?

Through these means, GEEIA has developed an optimum balance between exception reporting, where applicable, while maintaining positive control on each and every job. Each region and squadron maintains a control board displaying the same data on its participation efforts as is displayed at the master control center in the Griffiss headquarters.

A virtual real-time status of the installation and maintenance problems between GEEIA headquarters and its overseas regions is made possible by using a telex machine as an integral part of the control room. The Pacific Region also has direct telex access to its squadrons in the Philippines and Japan.

This management-information seeking activity has been extended to include those jobs that have been totally supplied in the field, but not yet started. In other words, all the equipment involved in the installation is there, but the installation has not yet begun.

Those problems which are beyond GEEIA's control, such as delays in allied construction or changes in the using command's requirements, are pinpointed and brought to the attention of the organization concerned. Similar information is forecast for succeeding quarters of the year so that preventive action may be taken before it becomes a problem.

In addition, periodic meetings with major command GEEIA customers, and a GEEIA Management Performance System, among others, are used to keep an accurate pulse of the agency's performance.

From January to December 1968, GEEIA reduced delinquent jobs from over 2,000 to 970. The delinquent jobs in Southeast Asia are down from a high of over 300 to just over 80—a decrease in the rate of delinquency from over 20 percent to a low of 8 percent. In the maintenance area, the delinquent jobs dropped from 250 to 50. Along with the overall reduction in delinquencies, GEEIA's production, measured by jobs completed, increased more than 30 percent in the past year.

Consolidation of Systems Engineering Efforts

To further improve responsiveness and efficiency, systems engineering efforts are being consolidated at Headquarters, GEEIA.

In the past, each major command dealt with the individual GEEIA re-

gion on many of its long-range CEM program requirements. By consolidating the pre-CEIP (Communications Electronics Implementation Plan) systems engineering responsibility in its headquarters at Griffiss AFB, GEEIA will have the perspective to evaluate total requirements. The customer will receive more responsive support through more detailed and realistic GEEIA programming. Some 8 to 10 requests a week come in from the various using commands for help in pre-CEIP efforts. This benefits both GEEIA and the requestor in several ways.

First, the specifications and equipments are put into the CEIP in such a manner that it is not rejected by Air Force for faulty format, imprecise specification, or erroneous details. Second, resources can be programmed by GEEIA more adequately to do the job, when it appears on the PCSP (Programmed Communications Support Program) issued by the CEM division of AFLC's Deputy Chief of Staff for Operations. Third, the customer and the Air Force, as a whole, benefit by having the command and control facility engineered, installed and working on a timely schedule. Timeliness is considered so important that once a task is accepted and programmed, GEEIA's Forecast Support Date can be delayed or changed only upon approval of the agency's commander. Such a decision is not delegated to any lower level in the organization.

Other actions have been taken to improve customer support capability:

- **Standardization of organizations, functions and operating procedures in all regions.** These activities, in conjunction with a completely automated GEEIA management system, insure effective management control of GEEIA resources world-wide and allow rapid response in support of emergency and high-priority GEM requirements anywhere in the world.

- **Continual self appraisal of capability, workload and resources.** This permits realignment of types and locations of skills to be most responsive to users' needs.

- **Development of manning criteria and direct labor formulas.** Proper distribution and utilization of manpower resources for long-range workload planning is recognized as a key aspect in successful job performance.

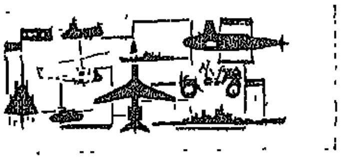
- **Long-range forecasting of CEM workload through the U. S. Air Force Command Control and Communications Program.** This program is extremely important to GEEIA since it includes the bulk of the communications-electronics program within the Air Force. It is an extension of the Air Force and DOD programming systems, and entails an annual program project spanning an eight-year period. GEEIA is working closely with each major command to insure that ground CEM requirements of the command are included in the annual communications - electronics submission. Only if the major commands prepare this document properly and on a timely basis can GEEIA effectively forecast workload and resource requirements to support its many customers. As an additional byproduct, skill distribution can be be adjusted to accomplish projected workload.

- **Quarterly reviews attended by GEEIA representatives, plus meetings with CEM Boards of the major commands.** These provide an avenue for exchange of advanced information on what the future requirements will be, and give GEEIA an extra break to assure that jobs are completed on time.

- **Dialogue with primary users and suppliers.** Regular meetings are scheduled between GEEIA and the Air Force Communications Service, U. S. Air Force Security Services, the Air Force Systems Command's Electronic Systems Division, and the Air Force Logistics Command's Oklahoma Air Materiel Area. These meetings provide an opportunity for face-to-face sessions between some of the biggest users of GEEIA's service and the primary suppliers of the equipment. Potential problem areas are resolved before they actually arise. During the past year, these meetings can be credited with providing the proper atmosphere that reduced many of the problems which have traditionally plagued GEEIA efforts in the ground CEM environment.

Through management improvement techniques and the efforts of each member—from the installers in the Vietnam jungles to the engineers in headquarters and the regions—GEEIA has become truly a "can do" outfit, getting the job done on time and in a quality manner wherever it is called upon to do it. These efforts have provided the Air Force the ground communications-electronics-meteorological environment to carry out its mission to "fly and fight" in the increasingly complex milieu, where the F-4 and the satellite operate in place of the carrier pigeon and mule-drawn caisson.

Two members of the 2862nd GEEIA Squadron work on an "AK" building in support of the Navy's Poseidon Program, Cape Kennedy AFS, Fla.



DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of April 1969.

DEFENSE SUPPLY AGENCY

1—Trenton Textile Engineering and Manufacturing Co., Inc., Trenton, N.J. $1,492,929. 199,323 wet weather parkas Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1867

—Texaco Inc., New York, N.Y. $3,764,739 24,612,600 gallons of automotive gasoline Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1271.

—GAS Corp., New York, N.Y. $1,640,905 83,480 packages of radiographic film. Defense Personnel Support Center, Philadelphia, Pa DSA 120-69-C-4262.

—Trenton Textile Engineering and Manufacturing Co., Trenton, N J. $1,029,452. 124,180 men's wet weather coated overalls. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1882

4—So-Sew Styles, Inc., Centre, Ala $1,157,089. 153,664 men's blue wool flannel jumpers Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1910.

—J. P. Stevens and Co., Inc., New York, N.Y. $1,456,447. 2,750,000 yards of sateen cotton cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1887.

—Riegel Textile Corp., New York, N Y. $6,916,636 2,200,000 yards of sateen cotton cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1888.

—Burley Processing Co., Burley, Idaho. $1,221,926. 262,080 cases of dehydrated potatoe slices Defense Personnel Support Center, Philadelphia, Pa. DSA 137-69-C-CC31.

7—Consolidated Bag Corp., Philadelphia, Pa. $2,816,811. 10,200,000 acrylic sand bags. Defense General Supply Center, Richmond, Va. DSA 400-69-C-4685.

—Dowling Bag Co., Valdosta, Ga $1,041,255. 3,750,000 acrylic sand bags. Defense General Supply Center, Richmond, Va. DSA 400-69-C-4686.

—Cavalier Bag Co., Inc., Lumberton, N.C. $3,607,214. 13,000,000 acrylic sand bags. Defense General Supply Center, Richmond, Va DSA 400-69-C-4686.

—Star-Kist Foods, Inc., Terminal Island, Calif. $1,008,347. 56,576 cases of canned tuna. Defense Personnel Support Center, Philadelphia, Pa DSA 134-69-C-0825.

—Milcom Products, Inc., Rochester, N.Y. $1,450,357 105,020 body armor fragmentation protective vests. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1785.

—Trenton Textiles Engineering Manufacturing Co., Inc., Trenton, N.J. $1,136,520. 82,000 body armor fragmentation protective vests. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1784

8—Stone Manufacturing Co., Columbia, S.C. $1,018,282 2,200,830 pairs men's thigh length cotton drawers. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1954.

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company—Value—Material or Work to be Performed—Location of Work Performed (if other than company plant)—Contracting Agency—Contract Number.

9—Inflated Products Co., Inc., Beacon, N.Y $3,113,815 466,140 pneumatic mattresses. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1965.

—Bannercraft Clothing Co., Inc., Philadelphia, Pa. $1,719,550 86,000 men's wool serge coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1947

—Tursini and Co., Vineland, N.J. $1,174,513 65,070 men's wool serge coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1948

—Dale Fashions, Inc., Vineland, N.J. $2,619,072. 127,400 men's wool serge coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1946

10—Michael, Inc., Philadelphia, Pa. $1,119,000. 50,000 men's green wool serge coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1941.

—Albert Turner Co., Inc., New York, N.Y. $1,106,000 50,000 men's green wool serge coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1942.

11—Burlington Industries, Inc., New York, N.Y. $3,324,330 859,000 linear yards of wool serge cloth. Defense Personnel Support Center, Philadelphia, Pa DSA 100-69-C-1995.

—Southern Worsted Mills, Inc., Boston, Mass $1,847,000. 500,000 linear yards of wool serge cloth Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1994.

—Burlington Industries, Inc., New York, N.Y. $1,836,000. 400,000 linear yards of wool garbardine cloth. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1996

—J. P. Stevens and Co., Inc., New York, N.Y. $1,050,400. 232,000 linear yards of wool gabardine cloth. Defense Personnel Support Center, Philadelphia, Pa DSA 100-69-C-1997.

14—Marmac Industries, Inc., Marysville, Mich. $1,231,697. 511,290 helmet liners Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2004.

—International Harvester Co., Melrose Park, Ill. $1,336,129. 38 various size full-tracked tractors. Defense Construction Supply Center, Columbus, Ohio DSA 700-69-C-9471.

17—Westinghouse Air Brake Co., Peoria, Ill. $1,186,000. 69 earthmoving scrapers. Poccoa, Ga. Defense Construction Supply Center, Columbus, Ohio DSA 700-68-C-9823 Mod P002.

18—Milcom, Inc., Rochester, N Y. $1,102,585. 811,760 cotton duck belts. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2038.

22—Tennessee Overall Co., Inc., Tullahoma, Tenn. $1,353,631. 576,560 pairs of men's polyester wool tropical trousers. Defense Personnel Support Center, Philadelphia. Pa. DSA 100-69-C-2071.

23—Foster Industries, Inc., New York N.Y. $1,263,654. 416,710 men's tricot knit nylon triacetate sleeping shirts Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2076.

24—Pettibone Mulliken Corp., Washington, D.C. $5,647,933. 149 rough terrain fork-lift trucks of 10,000 pound capacity Defense General Supply Center, Richmond, Va. DSA 400-69-C-5415.

25—Sinclair Oil Corp., New York, N.Y. $2,615,891. 22,600 gallons premium gasoline, 9,916,900 gallons regular gasoline, 701,800 gallons kerosene, 2,797,000 gallons diesel fuels and 6,171,500 gallons fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1263.

—Murphy Oil Corp., El Dorado, Ark. $1,050,272. 3,750,000 gallons regular gasoline, 3,520,000 gallons diesel fuel and 1,475,000 gallons fuel oils Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1256.

—Raymer Bag Corp., New Bedford, Mass. $1,946,913. 7,050,000 acrylic sandbags. Defense General Supply Center, Richmond, Va. DSA 400-69-C-5696.

—Inflated Products Co., Inc., Beacon, N.Y. $1,001,064. 149,860 nylon pneumatic mattresses. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-1965.

28—Rachman Manufacturing Co., Reading, Pa. $1,284,852. 104,290 fragmentation protective body armor vests. Defense Personnel Support Center, Philadelphia, P DSA 100-69-C-2061.

29—M.L.W. Corp., Bayamon, Puerto Rico, $1,430,000. 1,000,000 pairs of men's wind resistant cotton trousers Defense Personnel Support Center Philadelphia, P DSA 100-69-C-2149

30—U&W Manufacturing Co., Inc., Selma Ala. $1,322,457. 919,600 pairs of men cotton sateen trousers. Defense Personnel Support Center, Philadelphia, Pa DSA 100-69-B-2162.

DEPARTMENT OF THE ARMY

1—Olin Mathieson Chemical Corp., East Alton Ill. $7,948,880 7.62mm NATO ball cartridges (M80) and M62 linked tracers DA-AA25-69-C-0089. $2,354,419. 5.56mm tracer cartridges (M196). DA-AA25-69-C-0086. $10,151,736. Clipped 7.62mm NATO ball cartridges. DA-AA25-69-C-0090. Work will be done at New Haven, Conn., and East Alton, Ill Frankford Arsenal, Philadelphia, Pa.

—Remington Arms Company, Inc., Bridgeport, Conn. $6,796,473. 7.62mm NATO ball and tracer cartridges (M80 and M62) Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C-0088.

—Bulova Watch Co., Jackson Heights, N.Y. $2,365,398. Metal parts for point detonating fuzes for 81mm projectiles (M374). West Valley Spring, N.Y. Cincinnati, Ohio, Procurement Agency. DA-AA09-69-C-0256.

—John R. Hollingsworth Co., Phoenixville, Pa $1,268,594 (contract modification). 3 KW, 28-volt generator sets. Army Mobility Equipment Command, St Louis, Mo. DA-AK01-68-C-1573.

—General Electric Co., Syracuse, N.Y. $5,519,262. AN/MPQ-4A radar sets. Syracuse, N.Y., and Pittsfield, Mass. Army Electronics Command, Philadelphia Procurement Division, Philadelphia, Pa. DA-AB05-69-C-0417.

—Hesse-Eastern Div., Norris Industries, Inc., Brockton, Mass. $9,263,666 66mm rocket launchers. New York Procurement Agency, N.Y. DA-AA09-69-C-0085.

—Magnavox Co., Urbana, Ill. $3,803,6[illegible]. AN/ARC-131 VHF-FM radio sets. Procurement Division, Army Electronics Command, Fort Monmouth, N.J. AF-31-601-68-A1489.

—P.R.D. Electronics, Inc., Westbury, L.I., N.Y. $3,133,157 (contract modification). AN/USM-234 microwave sets. Army Missile Command, Huntsville, Ala. DA-AH01-68-C-1992.

—Construction, Ltd., Bordentown, N.J. $1,561,300. Modification of three buildings. Fort Meade, Md. Baltimore Engineer District. DA-CA31-69-C-0068.

—Texas Instruments, Inc., Dallas, Tex. $5,800,000. Infra-red detecting sets, AN/AAS-24, and test equipment. Army Electronics Command Procurement Division.

Fort Monmouth, N J DA-AB07-69-C-0257.

—Collins Radio Co., Richardson, Tex. $1,909,812. AN/TRC-132A radio terminal sets. Chicago Procurement Agency DA-AB07-67-C-0181

—Continental Motors Corp., Mobile, Ala $1,175,428 (contract modification). Overhaul of LDS 427-2 multi-fuel engines for 2½-ton trucks. Brookley AFB, Ala. Army Tank Automotive Command, Warren, Mich. DA-AE07-68-C-2001.

—FMC Corp., Charleston, W. Va. $1,500,000. M548 cargo carriers with material handling kits and personnel heaters Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-0751.

—J. R. Youngdale Construction Co., Inc., and E. W. Johnson, San Diego, Calif. $1,419,300. Construction of maintenance dock for aircraft fueling system, Altus AFB, Okla. Albuquerque, N. M., Engineer District. DA-CA47-69-C-0075.

—Kasch Brothers, Inc., Big Springs, Tex. $2,010,500. Construction of a composite medical facility at Keese AFB, Texas. Albuquerque Engineer District. DA-CA47-69-C-0086.

—Kasch Brothers, Inc., Big Springs, Tex. $1,958,500. Construction of composite medical facility, Webb AFB, Texas. Albuquerque Engineer District. DA-CA47-69-C-0087.

—General Motors Corp., Detroit, Mich. $2,008,503 (contract modification). 100 KW, 60-cycle generator sets. Mobility Equipment Command. DA-AK01-68-C-6220.

—Harnischfeger Corp., Milwaukee, Wis. $4,998,000 (contract modification). 20-ton truck mounted cranes. Escanaba, Mich. Mobility Equipment Command. DA-AK01-69-C-7411.

—Varo, Inc., Garland, Tex $1,420,000. Shoulder operated, 40mm grenade launchers (M79). Mexia, Texas. Army Weapons Command, Rock Island, Ill DA-AF03-69-C-0077.

—Ametek, Inc., Sheboygan, Wis. $1,226,172 (contract modification) Support assemblies for ammunition fiber containers (M105A2). Plymouth, Wisc. Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-AA-9-67-C-0122.

2—Raytheon Co., Andover, Mass. $8,688,150 (contract modification). Engineering services for improved Hawk missile system and value engineering program requirements. Andover, Mass, and Bedford, Mass. Army Missile Command, Huntsville, Ala. DA-AH01-69-C-0099.

3—Umbqua River Navigation Co., Reedsport, Ore. $4,044,400. Construction of south jetty on the Pillamook Bay and Bar, Oregon, Project. Portland, Ore., Engineer District. DA-CW57-69-C-0091.

4—Algernon Blair, Inc., Montgomery, Ala. $12,855,300. Construction of nine enlisted men barrack complexes, including dental clinic, two gymnasiums, supporting utilities and site work. Fort Bragg, N.C. Savannah, Ga., Engineer District. DA-CA21-69-C-0087.

—Whirlpool Corp., Evansville, Ind. $1,800,434. 152mm canister (XM626) fabrication and assembly. Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0363.

—Northrop Corp., Anaheim, Calif. $2,292,916. Fabrication and assembly of 152mm canisters (XM626) Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0362.

—I. D. Precision Components Corp., Jamaica, N.Y. $1,090,132. Metal parts for point detonating fuzes (M524A5) for 81mm mortars. Gadsden, Ala., and Jamaica, N.Y. New York, N Y., Procurement Agency. DA-AA09-69-C-0301.

—Colt's Inc., Hartford, Conn. $2,205,000 (contract modification). 20-round magazine assemblies for M16 weapons. Army Weapons Command, Rock Island, Ill. DA-AF03-69-C-0007.

7—Airport Machining Corp., Martin, Tenn. $3,093,750 (contract modification). Metal parts for 2.75 inch rocket warheads. Union City, Tenn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0087.

—R.E.D.M. Corp., Wayne, N.J. $1,287,000. Metal parts for 81mm cartridge mortar fuzes. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0281.

8—Hayes International Corp., Birmingham, Ala. $1,155,056 (contract modification). Metal parts for 2.75 inch rocket warheads. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0135.

9—Hamilton Watch Co., Lancaster, Pa. $9,118,005 Mechanical time fuzes for artillery shells. East Petersburg, Pa. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0252.

—Riverside Research Institute, New York, N.Y. $1,599,000 ARPA developed Advanced Measurements Radar operation and maintenance, and processing data for missile in-flight data. White Sands Missile Range, White Sands, N.M. DA-AD07-69-C-0035.

10—Western Electric Co., New York, N.Y $1,327,070 (contract modification) Additional research and development on Safeguard Ballistic Missile System Santa Monica, Calif, and Whippany, N J. DA-30-069-AMC-00333(Y).

11—Ralph M. Parsons Co., Los Angeles, Calif. $1,876,667 (contract modification). Architect engineer services in development of criteria for tactical structures for Missile Support Radars in the Safeguard Defense System. Army Engineer Division, Huntsville, Ala. DA-CA01-67-C-0010.

—Nabholtz Construction Corp., Conway, Ark. $1,500,300. Construction of a loading and assembly facility at Pinebluff Arsenal, Ark. Army Engineer District, Fort Worth, Tex. DA-CA62-69-C-0135.

—Lockheed Electronics Co., Plainfield, N.J. $1,370,700. AN/VPS-2 radar systems for the Vulcan Air Defense System. Army Procurement Agency, New York, N Y. DA-AA25-68-C-0718.

—FMC Corp., San Jose, Calif. $1,030,000. Conversion kits for converting M113A1 armored personnel carriers to recovery vehicles San Francisco Army Procurement Agency, Oakland, Calif. DA-AG05-69-C-0600.

14—Domenic Leone Construction Co., Inc., Trinidad, Colo. $1,039,600. Construction of access roads for new range facility, Fort Carson, Colo Omaha, Neb., Engineer District. DA-CA45-69-C-0073.

—Electro-Mechanical Corp., Sayre, Pa. $1,153,733. Electrical equipment shelters. Binghamton, N.Y. Procurements Division, Army Electronics Command, Philadelphia, Pa. DA-AB05-69-C-0126.

15—Ford Motor Co., Highland Park, Mich. $2,837,189 (contract modification). ¼-ton utility trucks (M151A1). Project Manager, General Purpose Vehicles, Warren, Mich. DA AE-06-68-C-0001.

—Atlas Chemical Industries, Inc., Wilmington, Del. $2,884,958 (contract modification). Manufacture of TNT and related material. Volunteer Army Ammunition Plant, Chattanooga, Tenn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-531(A).

16—Martin Marietta Corp., Orlando, Fla. $2,386,750. Advanced development models of the random access discreet address (RADA) communication system. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0231.

—Dynalectron Corp., Fort Worth, Tex. $3,407,531. Maintenance on quarry and highway construction equipment in Vietnam. Army Mobility Equipment C mmand, St. Louis, Mo. DA-AK01-69-A-2425(D4).

17—Olin Mathieson Chemical Corp., New York, N.Y. $2,156,342 (contract modification). Production of various propellants and support activities at the Badger Army Ammunition Plant, Baraboo, Wis. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0014.

—Continental Motors Corp., Muskegon, Mich. $4,853,207 (contract modification). AVDS 1790-2A engines for M60 tank. Army Tank Automotive Center, Warren, Mich. DA-AE07-69-C-0534.

—KDI Precision Products, Inc., Cincinnati, Ohio. $1,422,150 (contract modification). Point detonating fuzes for 2.75 inch rockets. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0196.

—Amron Corp., Waukesha, Wis. $2,244,874. Metal parts for M43A1 grenades. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0395.

—Weymouth-Fordice, Memphis, Tenn. $1,486,300. 150,000 squares of cast articulated concrete mattresses for revetments for the Flood Control Mississippi River and Tributaries Project, St. Francisville, La. New Orleans Engineer District. DA-CW29-69-C-0136.

—Radio Corporation of America, Burlington, Mass. $5,236,350. Refurbishing and updating Land Combat Support System demonstration and service test models. Army Missile Command, Huntsville, Ala. DA-AH01-69-C-1437.

18—Physics International Co., San Leandro, Calif. $1,198,733 (contract modification). Construction of a high voltage generator for a gamma ray simulation facility. Defense Atomic Support Agency, Washington, D.C DA-SA01-68-C-0175.

21—Remington Arms Co., Bridgeport, Conn. $14,455,058 (contract modification). Operation and maintenance of Lake City Ammunition Plant, Independence, Mo Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-19-010-AMC-00003(A).

—Day and Zimmermann Co., Philadelphia, Pa $13,028,068 (contract modification). Load, assemble and pack artillery ammunition and components Lone Star Army Ammunition Plant, Texarkana, Tex. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00114(A).

—Federal Cartridge Corp., Minneapolis, Minn. $8,375,506 (contract modification). Load, assemble and pack 7 62mm and 5 56mm ball and tracer ammunition Twin Cities Army Ammunition Plant, New Brighton, Minn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-36-038-AMC-1099(A).

—National Union Electrical Corp., Bloomington, Ill. $6,372,450 (contract modification) Metal parts for 750-lb bomb nose fuzes Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0068.

—Raytheon Co., Lexington, Mass. $2,956,500 (contract modification). Metal parts for 750-lb. bomb nose fuzes Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0070.

—Batesville Manufacturing Co., Batesville, Ark. $2,408,700 (contract modification). Metal parts for 750-lb bomb nose fuzes. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0069.

—Scovill Manufacturing Co., Waterbury, Conn. $1,531,014 (contract modification). Cluster bomb fuzes Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0141.

—Silas Mason Co., Inc., New York, N.Y. $1,113,324 (contract modification). Load, assemble and pack bombs mines and selected ammunition. Cornhusker Army Ammunition Plant, Grand Island, Neb. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-68-C-0383.

—Western Electric Co., Inc., New York, N.Y. $2,485,950. Nike Hercules improved kits. Burlington, N C. Army Missile Command, Redstone Arsenal, Huntsville, Ala. DA-AH01-68-A-0041.

—Firestone Tire and Rubber Co., Akron, Ohio. $2,248,322 (contract modification). Shoe assemblies for combat tank tracks. Noblesville, Ind. Tank Automotive Command, Warren, Mich. DA-AE07-69-C-2209.

—General Motors Corp., Anderson, Ind. $1,095,135 (contract modification). 12 volt storage batteries for general application, Anaheim, Calif. Tank Automotive Command, Warren, Mich. DA-AE07-69-C-1946.

—AVCO Corp., Stratford, Conn. $1,000,160 (contract modification). Gas turbine engines for OV-1 Mohawk aircraft Aviation Materiel Command, St. Louis, Mo. DA-AJ01-68-C-1874.

22—TRW, Inc., Cleveland, Ohio. $1,927,080. Bolt and roller assemblies for M14 rifles. Army Weapons Command, Rock Island Arsenal, Ill. DA-AF01-68-C-0608.

—Brunswick Corp., Sugar Grove, Va. $1,459,001. XM202 launchers and XM 74 rocket clips. Edgewood Arsenal, Dover, Del. DA-AA15-69-C-0599.

23—Hayes Albion Corp., Albion, Mich. $2,006,400. Metal parts for 2.75 inch rocket warheads. Hillsdale, Mich. Army Procurement Agency, Cincinnati, Ohio. DA-AA09-69-C-0332.

24—IBM Corp., Owego, N.Y. $5,500,000. Classified electronic work. Army Electronics Command, Fort Monmouth, N.J.

—AVCO Corp., Stratford, Conn. $1,309,112. Conversion kits for T-55-7C turbine engines for CH-47 helicopters. Army Aviation Materiel Command, St. Louis, Mo. AF 41-608-69-A2421.

—Bell Helicopter Co., Ft. Worth, Tex. $1,325,060. Main rotor hub assemblies for AH-1G helicopters, Hurst, Tex. Army

Aviation Materiel Command, St. Louis, Mo DA-AJ01-69-A-0314

25—Raytheon Co., Lexington, Mass $3,217,500 (contract modification) Metal parts for 750-pound bomb tail fuzes. Bristol, Tenn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0073.

—Raytheon Co., Andover, Mass $2,364,998 Various quantities of self-propelled Hawk ground support equipment Army Missile Command, Redstone Arsenal, Huntsville, Ala DA-AH01-69-C-1388

—Maremont Corp., Saco, Maine $1,699,125 (contract modification) M60, 7.62mm machine guns. Army Weapons Command, Rock Island, Ill. DA-AF03-69-C-0050

—Pace Corp., Memphis, Tenn. $1,467,686 (contract modification) Illuminating parachute signals Memphis, Tenn, and Camden, Ark. Picatinny Arsenal, Dover, N.J. DA-AA21-68-C-1102

—Ralph M. Parsons Co., Los Angeles, Calif $1,297,751 (contract modification). Continuing engineering service in support of design of the Missile Site Radar in the Safeguard Missile System. Engineer Division, Huntsville, Ala. DA-CA87-68-C-0001

—Bowen-McLaughlin-York, Blair, Pa. $1,157,390. Belly armour installation kits for the M113 family of vehicles. Army Tank Automotive Center, Warren, Mich. DA-AE07-69-C-4378.

—Bell Helicopter Co., Ft. Worth, Tex. $1,144,275. Tail rotor blades for UH-1 helicopters. Hurst, Tex Army Aviation Materiel Command, St Louis, Mo. DA-AJ01-69-A-0314.

28—Norris Industries, Inc., Los Angeles, Calif. $2,500,959. Metal parts for 81mm high explosive projectiles. Army Ammunition Plant, Riverbank, Calif. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0290.

—Kaiser Steel Corp., El Monte, Calif. $2,199,120 (contract modification). Metal ammunition box assemblies (M2A1). Linde Industries, Culver City, Calif. Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C-0186.

—Continental Motors Corp., Muskegon, Mich. $1,721,100. Cylinder assemblies for M60 tank. Muskegon, Mich., and Oberdorfer Foundries, Inc., Syracuse, N.Y. Army Tank Automotive Center, Warren, Mich. DA-AE07-69-C-2776.

—General Motors Corp., Cleveland, Ohio $3,784,000 (contract modification). Interim phase advanced production engineering on the XM70 Main Battle Tank. Cleveland and Milwaukee, Wis. Army Tank Automotive Center, Warren, Mich. DA-AE07-68-C-3097

—Philco Ford Corp., Newport Beach, Calif. $1,995,515. Analysis, design specification and development of a platform sensor system. Safeguard System Command, Huntsville, Ala. DA-HC60-69-C-0085.

29—Clark Equipment Co., Battle Creek, Mich. $1,003,528. Rough terrain fork lift trucks. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-69-C-7793.

—United Aircraft Corp., Stratford, Conn. $21,975,000. CH-54B (TARHE) helicopters with engine particle separators and armor data Army Aviation Materiel Command, St Louis, Mo. DA-AJ01-68-C-0827.

—Page Communications Engineers, Inc., Sierra Vista, Ariz. $2,858,331. Operation and maintenance of the integrated wide band communication system (IWCS) in Thailand. Army Procurement Division, Fort Huachuca, Ariz. DA-AE18-69-C-0155.

—Page Communications Engineers, Inc., Sierra Vista, Ariz. $4,276,331. Operation and maintenance of IWCS sites in Vietnam. Army Procurement Division, Fort Huachuca, Ariz. DA-EA18-69-C-0154.

—Uniroyal, Inc., New York, N.Y. $2,444,536 (contract modification). Manufacture of explosives, and loading, assembling and packing ammunition at the Army Ammunition Plant, Joliet, Ill. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-62(A).

—Kilby Steel Co., Anniston, Ala. $2,060,329. Body assemblies and base plugs for 8-inch high explosive projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0399.

—Chamberlain Manufacturing Corp., Elmhurst, Ill. $7,760,400. Metal parts (M437) for 175mm projectiles. Scranton Army Ammunition Plant, Scranton, Pa. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0225.

—U.S. Steel Corp., Pittsburgh, Pa. $7,515,500. Metal parts (M106) for 8-inch projectiles Berwick, Pa., Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0226.

30—White Motor Corp., Lansing, Mich $2,407,912 (contract modification) Engineering services for 2½-ton trucks (M-44 and M-600 series) Army Tank Automotive Center, Warren, Mich. DA-AE07-67-C-5674.

—Pace Corp., Memphis, Tenn. $1,562,630. White Star illuminating signals (M127A1) Camden, Ark., and Memphis Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0519.

—Bulova Watch Co., Flushing, N.Y. $3,567,629. Mechanical time fuzes for mortar and artillery rounds. Woodside, N.Y. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0242.

—Raytheon Co., Norwood, Mass. $1,756,327. Telephone signal converters, CV-1548-A/G. North Dighton, Mass Army Procurement Agency, New York, N.Y. DA-AB05-69-C-1011.

—Philco Ford Corp., Newport Beach, Calif. $1,346,505. Chaparral simulator evaluators (advanced development program) Army Missile Command, Huntsville, Ala DA-AH01-69-C-1571.

—A. O. Smith Corp., Chicago, Ill $8,493,300. Metal parts for 750-pound bombs. M.K.T. Railroad Shop, Bellmead, Tex., American Steel Pipe Co, Birmingham, Ala., and other subcontractors (31%). Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-AA09-69-C-0398.

—Connecticut Cartridge Corp., Plainville, Conn. $2,832,346. 20mm brass cartridge cases (M103) Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C-0512.

—Firestone Tire and Rubber Co., Akron, Ohio. $3,590,266. Support services, and loading, assembling and packing 155mm projectiles and related ammunition components. Ravenna, Ohio, Ammunition Plant. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-65(A).

DEPARTMENT OF THE NAVY

1—TRW, Inc., Redondo Beach, Calif. $2,388,400. Design, development, documentation and manufacture of engineering models and prototypes for target designator systems. Naval Purchasing Office, Los Angeles, Calif N00123-69-C-0503.

—Leland Stanford Jr., University, Stanford, Calif. $1,290,000. Research work. Office of Naval Research, Washington, D.C.

—Robert L. Wilson, Inc., Oakland, Calif. $1,383,100. Construction of barracks at the Naval Hospital, Oakland, Calif. Naval Facilities Engineering Command, through Western Division, San Bruno, Calif. N62474-67-C-0731.

3—United Aircraft Corp., East Hartford, Conn. $34,600,000. Production support engineering services for TF30, J-34, J-48, J-52 and J-57/JT3 series aircraft engines. Naval Air Systems Command, Washington, D.C. N00019-69-C-0367.

—Garrett Corp., Phoenix, Ariz. $3,500,000 T76-G-10/12 engines for OV-10 aircraft for the Marine Corps and Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0404.

—Burnett Construction Co., Corpus Christi, Tex. $1,718,300. Aircraft paint shop construction, Corpus Christi Naval Air Station. Naval Facilities Engineering Command, through Gulf Division, New Orleans, La. N62468-69-C-0031.

—Astrophysics Research Corp., Los Angeles, Calif. $1,477,927. Research and investigative studies on the problems of Very Low Frequence systems. Navy Purchasing Office, Los Angeles, Calif. N00123-69-C-0997.

—Raytheon Co., Lowell, Mass. $1,489,904 (contract modification). Guidance and control groups for Chaparral missile. Naval Air Systems Command, Washington, D.C. N0019-69-C-0200.

—Northwest Construction Co., San Francisco, Calif $1,014,214 Construction of barracks at the Naval Air Station, Moffett Field, Calif Naval Facilities Engineering Command, through Western Division, San Bruno, Calif N62474-68-C-0136.

4—Grumman Aircraft Engineering Corp., Bethpage, L.I, N Y. $9,890,000 (contract modification) E-2C aircraft Naval Air Systems Command, Washington, D.C N00019-68-C-0542

—General Dynamics Corp., Pomona, Calif $3,290,000. Engineering services to investigate performance of Tartar/Terrier and Standard missiles as demonstrated by fleet firings. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2209.

7—Westinghouse Electric Corp., Pittsburgh, Pa $21,477,099. Designing and furnishing of nuclear propulsion components. Naval Ship Systems Command, Washington, D.C N00024-67-C-5058.

8—Sunstrand Corp., Rockford, Ill $3,246,329 (contract modification). Constant speed drives and frequency control boxes for FY 1969 F-4 program for Navy and Air Force Naval Air Systems Command, Washington, D.C N00019-68-C-0083.

—Norfolk Shipbuilding and Dry Dock Corp., Norfolk, Va $1,749,876. Dry docking and regular topside overhaul of amphibious transport dock USS Raleigh (LPD 1) Supervisor of Shipbuilding, Conversion and Repair, Fifth Naval District. IFB N62678-69-B-106.

—Burrows Corp., Detroit, Mich. $1,350,000. Cathode ray tube displays and related modules used in remote and central-user terminals of Message Processing and Distribution System. Paoli, Pa. Navy Purchasing Office, Los Angeles, Calif. N00123-69-C-0298.

—Consolidated Diesel Electric Co., Old Greenwich, Conn. $2,556,052. Production of diesel engine generator sets of various capacities. Old Greenwich, Conn., and Stockton, Calif Headquarters, Marine Corps, Washington, D.C M00027-69-C-0126.

9—United Aircraft Corp., East Hartford, Conn. $30,181,198 (contract modification) Procurement of TF30-P-12 and TF30-P-8 engines for the Air Force Naval Air Systems Command, Washington, D.C. N00019-67-C-0332.

—Norris Industries, Vernon, Calif. $1,758,472. Sidewinder missile motor tubes Naval Ordnance Station, Indian Head, Md N00174-69-C-0551.

10—ITT Gilfillan Inc., Los Angeles, Calif $16,000,000 (contract modification). AN/TPS/32 radar for primary tactical air control. Naval Electronic Systems Command, Washington, D.C. NOBSR 95136.

—Singer-General Precision Inc., Silver Spring, Md $3,500,000. Synthetic flight training system for helicopter pilot instrument flight training at the U.S. Army Aviation School, Fort Rucker, Ala. Naval Training Device Center, Orlando, Fla. N61339-69-C-0200.

—PRD Electronics, Inc., Jerico, L.I., N.Y $1,868,373 (contract modification). Fabrication and testing of Versatile Avionics Shop Test systems Westbury, L.I., N.Y. Naval Air Systems Command, Washington, D.C. N00019-67-C-0484.

—Lockheed Missile and Space Co., Sunnyvale, Calif. $1,490,621. Engineering and field engineering support for the Polaris program. Navy Strategic Systems Project Office, Washington, D.C. N00030-69-C-0196.

11—LTV Aerospace Corp., Dallas, Tex. $1,000,000. Development of interface between A-7 aircraft avionics and Versatile Avionics Shop Test systems. Naval Air Systems Command, Washington, D.C. N00019-69-C-0536.

—General Electric Co., Utica, N.Y. $5,310,000. AN/AXR-13 night classification systems. Naval Air Systems Command, Washington, D.C. N00019-69-C-0426.

—General Dynamics Corp., Pomona, Calif $1,441,210 (contract modification). Standard ARM missiles. Naval Air Systems Command, Washington, D.C. N00019-69-C-0074.

—Philco-Ford Corp., Palo Alto, Calif. $1,458,436. Manufacture of one pre-production model for Alternate Tactical Air Command Control for Phase I of the Marine Tactical Data System Naval Electronic Systems Command, Washington, D.C. N00039-69-C-3530.

—H. W. Stanfield Construction Corp., and S. L. Haehn Inc., San Diego, Calif. $1,597,332. Construction of recruit barracks

at the Marine Corps Recruit Depot, San Diego, Calif. Naval Facilities Engineering Command, through Southwest Division, San Diego, Calif. N62473-68-C-0123.

—H. B. Zachery Co., San Antonio, Tex. $1,067,000. Repair of runways and simulated carrier deck lighting and markings at Naval Air Station, Kingsville, Tex. Naval Facilities Engineering Command, through Gulf Division, New Orleans, La. N62468-69-C-0056.

14—Newport News Shipbuilding and Dry Dock Co., Newport News, Va. $1,330,000. Topside overhaul of the amphibious assault ship USS Boxer (LPH 4). Supervisor of Shipbuilding, Conversion and Repair, Fifth Naval District. RFP N62678-69-R-161.

15—Radio Corporation of America, Moorestown, N.J. $1,071,384. AN/UPS-1C radars. Naval Electronic Systems Command, Washington, D.C. N00039-69-C-3528.

16—Marinette Marine Corp., Marinette, Wis. $10,165,438. Eight repair, berthing and messing barges (YRBMs). Naval Ship Systems Command, Washington, D.C. N00024-69-C-0299.

17—Leon H. Perlin Co., Inc., Newport News, Va. $1,710,000. Construction of a bachelor officers quarters with mess facilities, Naval Amphibious Base, Little Creek, Va. Naval Facilities Engineering Command. N62470-69-C-0793.

—McDonnell Douglas Corp., St. Louis, Mo. $5,200,000 (contract modification). Long lead time effort for RF-4E aircraft for the Air Force. N00019-68-C-0495. $3,041,000 (contract modification). Parts and equipment for A-4M and TA-4J aircraft. Long Beach, Calif., and St. Louis. N00019-67-C-0170. Both awarded by Naval Air Systems Command, Washington, D.C.

—Northrop Corp., Newbury Park, Calif. $5,570,639. MQM-74A target drones. Naval Air Systems Command, Washington, D.C. N00019-69-C-0306.

—Sanders Associates, Inc., Nashua, N.H. $5,000,000 (contract modification). Airborne receiver/transmitters and associated equipment. Naval Air Systems Command, Washington, D.C. N00019-68-C-0630.

—Garrett Corp., Phoenix, Ariz. $1,258,125. GTCP-100-54 gas turbine engines with metal shipping containers. Naval Air Systems Command, Washington, D.C. N00019-69-C-0537.

—Curtiss-Wright Corp., Wood-Ridge, N.J. $1,123,675. Product support engineering services for J65 series engines. Naval Air Systems Command, Washington, D.C. N00019-69-C-0372.

21—Basic Construction Co., Newport News, Va. $2,216,950. Construction of barracks at the Naval Amphibious Base, Little Creek, Norfolk, Va. Naval Facilities Engineering Command, through Atlantic Division, Norfolk, Va. N62470-69-C-0737.

—Sperry Rand Corp., Syosset, N.Y. $1,599,000. Engineering services for Ships Inertial Navigation Subsystems during Poseidon conversion of USS James Madison (SSBN 627), US Daniel Boone (SSBN 629) and USS Von Steuben (SSBN 632). Newport News, Va. and Groton, Conn. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5374.

—Woerfel Corp., Milwaukee, Wis. $1,089,300. Construction of ground support equipment shop, automotive maintenance shop, supplies and equipment warehouse, squadron operations building, line fire station and heating plant. Gen. Mitchell Air National Guard Base, Wis. Naval Facilities Engineering Command, through Midwest Division, Great Lakes, Ill. N62465-68-C-0362.

22—Lockheed Aircraft Corp., Burbank, Calif. $4,290,000. P3C systems effectiveness studies. Naval Air Systems Command, Washington, D.C. N00019-69-C-0111.

—RCA, Burlington, Mass. $1,800,000. Magnetic airborne detection feature recognition signal processors. Burlington, Mass., and Camden, N.J. Naval Air Development Center, Johnsville, Pa. N62269-69-C-0061.

—Cutler Hammer, Deerpark, L.I., N.Y. $1,750,000. Airborne electrical countermeasure set components for RA-5C aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-69-C-2061.

—Electronic Communications Inc., St. Petersburg, Fla. $1,677,128. Radio sets and multicouplers for shipboard use. Naval Ship System Command, Washington, D.C. N00024-69-C-1264.

—North American Rockwell, Inc., McGregor, Tex. $1,297,418 (contract modification). Rocket motors for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0215.

—General Electric Co., West Lynn, Mass. $1,151,000. Maintenance of T64-GE6 aircraft engines. Naval Aviation Supply Office, Philadelphia, Pa. F34601-69-A-1028-GB27.

23—Riha Construction Co., La Mesa, Calif. $1,138,910. Construction of a communications electronics school at the Marine Corps Air Station, Twentynine Palms, Calif. Naval Facilities Engineering Command, through Southwest Division, San Diego, Calif. N62473-67-C-3049.

—Metropolitan Construction Co. of Missouri, Encino, Mo. $1,635,900. Construction of Marine Corps Exchange at the Marine Corps Air Station, El Toro, Calif. Naval Facilities Engineering Command, through Southwest Division, San Diego, Calif. N62473-68-C-0171.

—Vitro Corp. of America, Silver Spring, Md. $1,587,800. Technical assistance, equipment design, installation services, technical data test procedures and ship alteration control for guided missile surface ship weapons systems. Naval Ship Systems Command, Washington, D.C. N00024-69-C-0292.

24—Borg Warner, Santa Ana, Calif. $1,295,171. Recorder reproducer and provisioning documentation and services. Naval Avionics Facility, Indianapolis, Ind. N00163-69-C-0508.

—General Time, Peru, Ill. $1,128,627. MK 188 Zuni rocket fuzes. Naval Ship Parts Control Center, Mechanicsburg, Pa. N00104 69 C 0277.

25—FMC Corp., Minneapolis, Minn. $3,000,000. Fabricate, assemble, test and deliver a Mk 26 Mod 2 guided missile launching system, and a Mk 26 Mod 0 prototype. Fridley, Minn. Naval Ordnance Systems Command, Washington, D.C. N00017-68-C-2109.

—Sperry Rand Corp., Great Neck, N.Y. $1,000,000. Modernization program for Mk 76 Terrier guided missile fire control system. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2325.

—Red Samm Mining Co., Inc., Bellevue, Wash. $1,776,000. Construction of a storm sewer separation at the Naval Shipyard, Bremerton, Wash. Naval Facilities Engineering Command, through Northwest Division, Seattle, Wash. N62476 69 C 0033.

28—Honeywell, Inc., Minneapolis, Minn. $1,664,439 (contract modification). Altimeter sets and associated equipment. Naval Air Systems Command, Washington, D.C. N00019-69-C-0388.

29—Johns Hopkins University, Silver Springs, Md. $4,790,312. Advance research on surface missile systems. Naval Ordnance Systems Command, Washington, D.C. NOw-62-0604 C.

—General Electric Co., Pittsfield, Mass. $3,616,000. Production of Mark 73 Mod 2 director systems and ancillary equipment for Tartar missiles. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2408.

—Fine and Salzberg, Inc., Norfolk, Va. $2,220,473. Construction of barracks at the Naval Amphibious Base, Little Creek, Norfolk, Va. Naval Facilities Engineering Command, Washington, D.C. N62470 69 C-0737.

—Packard Bell Corp., Newbury Park, Calif. $1,856,750. Manufacture of AN/UPM-137 radar sets and associated parts. Naval Electronic Systems Command, Washington, D.C. N0039 68 C 2585.

30—G. L. Cory, Inc., San Diego, Calif. $1,816,768. Construction of an aircraft maintenance and test hangar for the Joint Parachute Test Facility, Naval Air Facility, El Centro, Calif. Naval Facilities Engineering Command, through Southwest Division, San Diego, Calif. N62473 68-C 0132.

DEPARTMENT OF THE AIR FORCE

1—Boeing Co., Seattle, Wash. $1,400,000. Installation and test support for the Hard Rock Silo Development Program. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69 C-0186.

—Boeing Co., Wichita, Kan. $1,045,104. Depot level modifications on B-52s. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-68 C 1653 P007.

—Radio Corporation of America, Burlington, Mass. $1,500,000. Development of a microelectronic noise jammer. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33615-69-C-1488.

Collins Radio Company, Cedar Rapids, Iowa. $18,100,000. Aircraft Flight Director Systems for C-135 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601 69 C-2162.

—Itek Corp., Palo Alto, Calif. $6,095,000. Production of radar sets for F-4E aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-68 C-1302-PZ08.

—Western Electric Co., New York, N.Y. $1,805,171. Engineering services for the 490L Overseas Autovon Program. Electronics Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-69 C 0170.

—Hallicrafters Co., Rolling Meadows, Ill. $1,333,328. Production of countermeasure equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1024.

Olin Mathieson Chemical Corp., Stamford, Conn. $1,033,442. Production of missile propellant and operation of Air Force Plant #80, Saltville, Va. San Antonio Air Materiel Area, AFLC, Kelly AFB, Texas. F41608-69 C-0002.

4—Lear Siegler, Inc., Grand Rapids, Mich. $3,061,192. Production of AJB/ASN 56 airborne computer components. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657 68-C 0206 P013.

7—Lockheed Aircraft Corp., Marietta, Ga. $8,000,000. HC-130N aircraft and related equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657 69 C 0001.

Bendix Corp., Teterboro, N.J. $2,108,407. Production of airborne navigation equipment. Aeronautical Systems Div., AFSC, Wright-Patterson AFB, Ohio. F33657-69 C-1028.

Avco Corp., Stratford, Conn. $4,235,366. Production of ballistic missile penetration aids. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701 68 C 0039.

8—Lockheed Aircraft Corp., Marietta, Ga. $7,704,218 (contract modification). Engineering, design, fabrication and installation of modified wing for C-130 B/E aircraft. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603 68 C 2530.

—Litton Systems Inc., Van Nuys, Calif. $1,606,011. Manufacture of ground radar components. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606 69 A 0193.

9—Conductron Corp., St. Charles, Mo. $18,446,400. Production of a weapon system training simulator and related ground equipment for A 7D aircraft. Aeronautical System Division, AFSC, Wright-Patterson AFB, Ohio. F33657 69-C 0628.

Loral Corp., Bronx, N.Y. $3,886,810. Production of airborne countermeasure systems for RF 4C aircraft. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F33657 68 A-0098.

Litton Systems, Inc., Woodland Hills, Calif. $2,846,750. Gyroscopes applicable to F-4 aircraft inertial guidance system. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F04606 68 A 0147.

Marwais Steel Co., Richmond, Calif. $2,670,993. Production of aircraft shelters. 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33600-69-C-0380.

—Boeing Co., Seattle, Wash. $1,107,440. Production of modification kits for the Bomarc instrumentation and range safety system. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F04606 68 A 0148.

10—Hallicrafters Co., Rolling Meadows, Ill. $1,538,800. Production of airborne countercomponents applicable to B-52 aircraft. Chicago, Ill. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-69-C 2927.

—Avco Corp., Cincinnati, Ohio. $1,578,760. Production of electron tubes for ground radar sets. Sacramento Air Materiel Area,

AFLC, McClellan AFB, Calif. F34601-68-A-4451.

11—**Chromaloy American Corp.**, San Antonio, Tex. $1,704,732. Repair and application of protective metallic coating on J-57 and J-75 compressor blades. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex F41608-68-D-1617

14—**Batesville Manufacturing Co.**, Batesville, Ark. $4,831,200 Production of bomb components. Armament Development and Test Center, AFSC, Eglin AFB, Florida F33657-68-C-0164.

15—**Bob Rutherford Construction Co.** Albuquerque, N.M. $1,500,000. Engineering, design and construction of a high explosive simulation test facility near Cedar City, Utah. Air Force Special Weapons Test Center, Kirtland AFB, N.M F29601-69-C-0097.

—**United Aircraft Corp.**, Hartford, Conn. $1,032,030. Production of component parts applicable to J-57 aircraft engines San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex N383-69000A.

—**McDonnell Douglas Corp.**, St. Louis, Mo $4,420,000. Modification of F-4 series aircraft. Robertson, Mo. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F34601-68-A-2919.

—**General Electric Co.**, West Lynn, Mass. $1,000,000. Design, development, fabrication and acquisition of long lead time items of special tooling for turbojet and turbo-prop engines. Aeronautical Systems Division, AFSC Wright-Patterson AFB, Ohio. F33657-69-C-1026.

16—**Chromalloy American Corp.**, New York, N.Y. $1,735,571. Repair and coating of J57 and TF33 engine guide vanes. West Nyak, N.Y. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F34601-68-A-2991-SA02.

—**McDonnell Douglas Corp.**, Long Beach, Calif. $13,500,000. Supplies and services for contract definition of an Airborne Warning and Control System. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass F19628-69-C-0195.

—**Boeing Co.**, Seattle, Wash. $17,500,000. Supplies and services for contract definition of an Airborne Warning and Control System. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F1928-69-C-0194.

17—**General Motors Corp.**, Indianapolis, Ind. $5,018,240. Production of turboprop aircraft engines and power sections. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0357.

18—**Adams-Russell Co.**, Waltham, Mass. $1,003,808. Production of antennas for various aircraft Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F33657-69-A-0015-RJ02.

—**United Aircraft Corp.**, Windsor Locks, Conn. $1,200,000. Research to obtain propellor and cyclic control technology. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33615-69-C-1720.

—**McDonnell Douglas Corp.**, St. Louis, Mo. $1,222,500. Prototype installation and flight testing of target identification system for F-4E aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0088.

23—**Marwais Steel Co.**, Richmond, Calif. $1,250,009. Production of aircraft shelters. 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33600-69-C-0880.

—**OMI Corp. of America**, Alexandria, Va. $1,833,497. Procurement of analytical photogrammetric steropolotters used for making maps. Southfield, Mich., and Rome N.Y. Rome Air Development Command, AFSC, Griffis AFB, N.Y. F30602-69-C-0301.

24—**McDonnell Douglas Corp.**, Tulsa, Okla. $1,814,852. Modification and repair of B-66 series aircraft. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-69-C-3817.

—**Northrop Corp.**, Palos Verdes Peninsula, Calif. $1,332,000. Modification kits for target identification equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0070.

29—**Crescent Precision Products, Inc.**, Garland, Tex: $3,670,021. Fin assemblies and related data for 750-pound bombs. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-69-C-3132.

30—**McDonnell Douglas Corp.**, Huntington Beach, Calif. $1,300,000. Advanced development of multiple solid fuel boosters for Thor launch vehicles. Santa Monica, Calif. Space and Missile Systems Command, AFSC, Los Angeles, Calif. F04701-69-C-0340

—**General Motors Corp.** Indianapolis, Ind $40,000,000. Supplies applicable to T-56 turboprop aircraft engines Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla F34601-69-C-0734.

—**Boeing Co.**, Seattle, Wa $2,004,083 Combat trainer launch instrumentation applicable to the Minuteman weapon system. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F04606-69-A-0171-QP10AA.

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DCAS Engineering To Be Reorganized

Reorganization of the engineering elements in the Defense Contract Administration Services (DCAS) at Headquarters, Defense Supply Agency, has been announced by Rear Admiral Joseph L. Howard, SC, USN, Director for DCAS.

A working group headed by the management engineering segment of the DCAS headquarters was assigned the responsibility of drawing up a plan for realignment of the organization structure of the more than 600 engineers in headquarters and 99 regional, district and defense contractor plant offices of DCAS.

Essentially, the reorganization provides a separation of engineering elements from other professional operations in contract administration. The seperation will provide DCAS engineering with an identity not previously recognizable, making it possible for military customers to deal directly with professional engineers in solving engineering problems.

Under the new proposal, the systems support engineers will become a separate engineering entity, reporting directly to the commander of the DCAS activity to which they are assigned.

The purpose of the proposed realignment is to focus engineering liaison services more directly on complex weapon systems for the benefit of the military buyer, the civilian producer, and the overall Defense Department administration of the contracts. This, it is hoped, will provide a sharply defined central point for the coordination of engineering policy for the benefit of all elements concerned with the production of defense supplies.

Additional advantages expected are fuller utilization of the diverse engineering resources within DCAS, the provision of regular channels for professional development and advancement, and a system that will more readily attract young professional engineers.

Normal production engineering and quality engineering performed in support of the Production and Quality Directorates will remain essentialy unchanged.

From The Speaker's Rostrum

(*Continued from Page 30*)

Future Trends

In conclusion, I want to respond as best I may to a request for comment on policy changes involving Foreign Military Sales and also to touch on some trends I discern in contemplating the future of both FMS and MAP. The new Administration is, of course, reviewing each of these undertakings; but no substantive policy changes have been announced. Meanwhile, several studies on these subjects are under way in the National Security Council and elsewhere.

As to future trends, I believe:

- Grant aid will probably remain at its present level in FY 1970, but will gradually decline thereafter.
- Sales to highly developed countries will probably decline as those countries strive to produce their own military equipments. They have already dropped from 97 percent of the total in FY 1962 to 68 percent last year.
- Sales to "oil rich" and less developed countries will probably increase.
- Technical components and "know-how" are likely to represent a major portion of sales to highly developed countries.
- Complete end items and systems will probably make up sales to "oil rich" and less developed countries—with increased emphasis on co-production.

Whatever lies ahead for the Military Assistance Program and Foreign Military Sales, I look forward to working closely with many of you in the future. I will welcome your assistance and cooperation in our activities and will appreciate any ideas, recommendations, criticisms (contructive or otherwise) you may care to volunteer as we move together into that future.

Computer Management Activity Established by Army CDC

U.S. Army Combat Developments Command (CDC), Fort Belvoir, Va., has established a new headquarters directorate to manage all types of computer activities related to developmental efforts at CDC.

The new element has been designated as the command's Automatic Data Processing/Management Information Systems Directorate (ADP/MIS) and is headed by Colonel Charles T. Caprino. In addition, former Deputy Comptroller/Deputy Director of Data Processing and Programs, Colonel Joseph E. Halloran Jr., has been appointed Comptroller/Program Coordinator for CDC. This office is a redesignation of the Comptroller/Director of Data Processing and Programs resulting from creation of the new ADP/MIS directorate.

Mission of the ADP/MIS Directorate is to oversee all computer activities of CDC's developmental program including Automatic Data Systems for the Army in the Field (ADSAF), management information systems, tables of organization and equipment, experimentation and testing, scientific modeling, and the instrumentation of computer technology.

ADP/MIS will assume responsibility for automatic data processing development programs handled by the Automatic Data Field Systems Command, which changed status in April to that of Computer Systems Command.

Army Seeking Fire-Fighting Helos

"Light water" and light helicopters are the basis of a new aircraft fire fighting system proposed by the Army's Medical Service Agency, Fort Sam Houston, Tex., a part of the Combat Developments Command.

"Light water" is a prefluorinated chemical solution which enables water to smother petroleum fires. In preliminary tests it has proven promising, the Army said.

The system, to be used in controlling aircraft fires during personnel rescue operations, consists of a light helicopter equipped with "light water" spray apparatus. The Army estimates that 25 gallons of "light water" sprayed from a telescoping or retractable boom could open a 20 by 40 foot path for three minutes for rescuers.

The Army calls for the spray equipment to weigh less than 500 pounds and to be mounted either externally or internally.

Air Force Forecasts 1969 Computer Needs

A tentative forecast of 11 computer equipment selections was issued by the Electronic Systems Division (ESD), Air Force Systems Command. The forecast is subject to change, according to ESD, and is issued for industry planning only.

Forecasts for requests for proposals for the second quarter of calendar year 1969 included: Headquarters, Office of Aerospace Research, selection of a computer; World-Wide Military Command and Control System, selection of data processing equipment for various elements; Air Force Logistics Command, replacement of nine computers; Seventh Aerospace Defense Command, Air Division Headquarters, replacement of Delayed Line Output SAGE equipment.

Third and fourth quarter forecasts include: Eastern/Western Test Ranges, replacement of 11 computers; Strategic Air Command, Replacement Project, replacement of six computers and part or all of three other systems; replacement of computers at the Air Force Academy, Air Force Rocket Propulsion Laboratory, Air Force Flight Test Center, Air Force Logistics Command Micromation and Air Force Logistics Command, Newark Air Force Station.

Interested companies should contact the Electronic Data Processing Equipment Office, ESD, L.G. Hanscom Field, Mass. 01730.

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New Terminal Equipment for AUTODIN Is in Advanced Test Phase

Electronic equipment, designed to eliminate separate teletype and data card terminal operations within the Defense Department's world-wide Automatic Digital Network (AUTODIN), is in advanced testing by personnel of the Air Force Communications Service headquartered at Scott AFB, Ill.

The equipment, designated Digital Subscriber Terminal Equipment (DSTE), will replace a variety of manual and semi-automatic terminal equipment now maintained and operated on an industrial contract basis. Most of the contracts will be terminated as the government-owned DSTE installations are completed.

The AUTODIN network is the world's largest digital communication system, providing DOD with high-speed transmission of information from punch card, paper tape, magnetic tape, or page copy form. Messages fed into the DSTE facilities will be processed, routed and transmitted automatically by AUTODIN.

Each DSTE site will be customized to meet the needs of the installation it serves. Component parts, such as the control unit, punch card and tape message keyboards, card readers, tape readers and page printers, can be combined in six different configurations to satisfy requirements. Message capacities range from 200 words per minute for the smallest terminal to 1,500 words per minute, plus 100 punch cards per minute, for the largest.

With the installation of the new system, the AUTODIN will be capable of faster communications with a larger message handling capacity, greater reliability and lower cost.

The tests, being conducted at Shephard AFB, Tex., with one of the initial production models, are providing the Air Force Communication Service (AFCS) realistic practice in maintaining and operating the system. AFCS personnel will eventually be responsible for about 600 of the DSTE installations. Army, Navy and other Air Force commands will operate an additional 440 units.

Delivery of the first DSTE units is expected about mid-1969, for use at overseas bases and installations. U.S. bases and stations [illegible]ct delivery of the DSTE system sometime in mid-1970.

DESC Assumes DOD Management of Integrated Circuits

The Defense Electronics Supply Center (DESC), Dayton, Ohio, has been assigned management responsibility for microelectronic circuit devices employed by the military and various Federal agencies.

The microelectronic circuits, also known as integrated circuits, are the 17th supply class assigned to DESC management. Identified within the defense logistics system as Federal Supply Class FSC 5962, they encompass approximately 1,950 Federal stock numbers managed by various DOD activities.

Officials foresee widespread future use for the integrated circuits. They are currently being designed into new electronic devices for the military, and industry expects military applications to account for one-half of the integrated circuit sales by 1970.

DESC now has complete logistic responsibility for FSC 5962. Prior to this, DESC was designated the Defense Department standardization activity for the class, which included coordination of specifications among the Services to avoid part duplications.

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DEFENSE INDUSTRY BULLETIN

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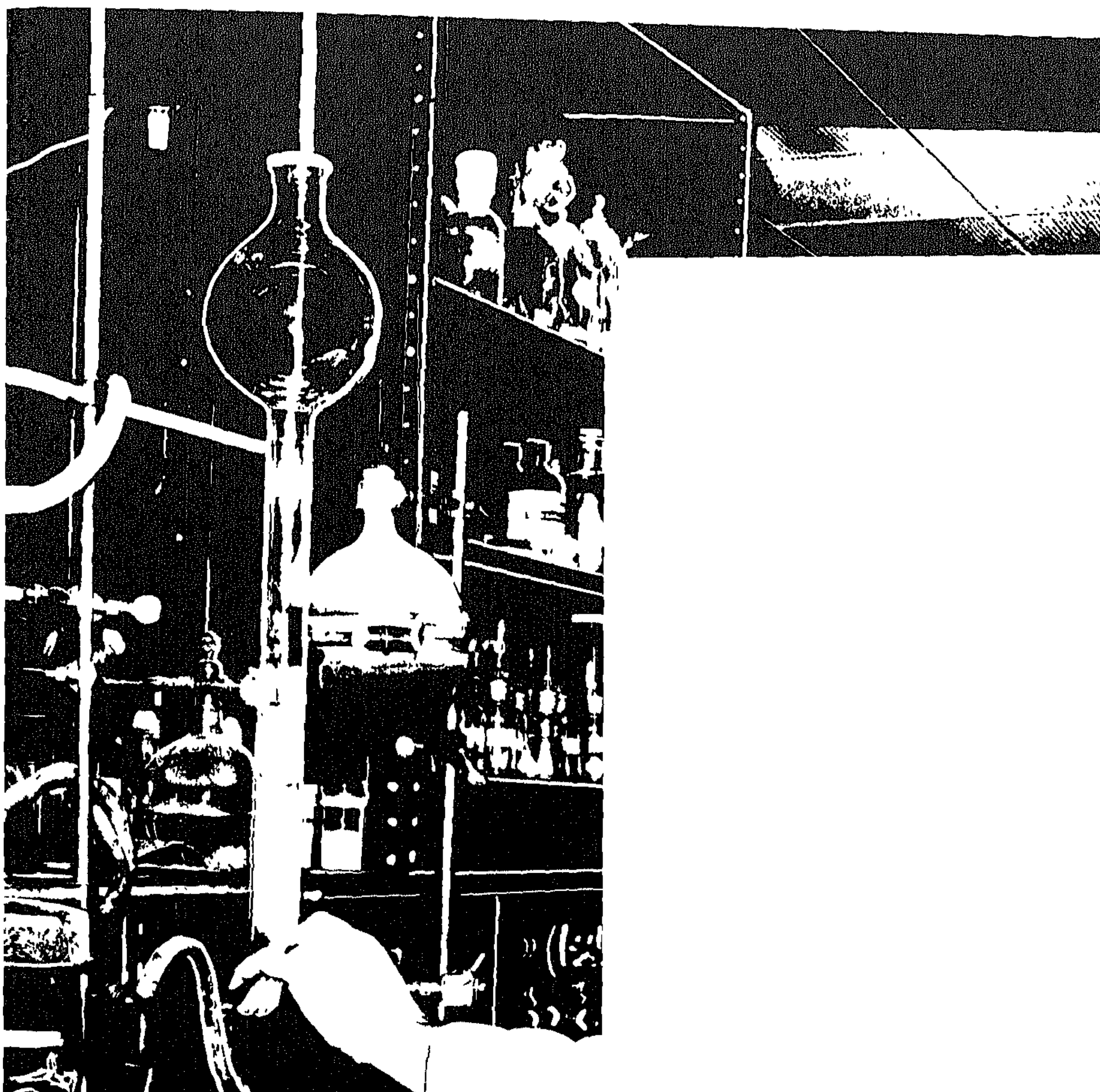

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Suggestions from industry representatives concerning possible topics for future issues are welcomed and should be forwarded to the Editor at the address shown below.

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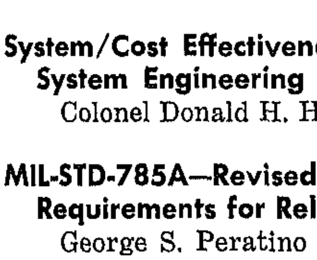

Basic research, as symbol on the cover, is the sourc our technological strength. 1 month, the *Defense Industry* letin explores the subject basic research at the Def Department level, and as ducted by the Army, Navy Air Force.

The Defense Research and Technology Base

[Editor's note: The following is an excerpt from the statement by Dr. John S. Foster Jr., Director of Defense Research and Engineering, on the FY 1970 Defense Research, Development, Test and Evaluation Program, presented on April 30, 1969, before the House of Representatives Committee on the Armed Services. It provides an appropriate preface to articles in this issue discussing organization and functions of the research activities of the Army, Navy and Air Force.]

The superiority of American military technology depends on many critical components—talented people, a commitment by many to excellence, our industrial capacity to apply new technology. But the ultimate source of our technological strength today is the research and technology base so carefully built up over the past 5, 10 and 20 years. In the same way, our future strength can only be ensured by vigorous, balanced investments made now in exploring new ideas. This need is just that simple. Yet the work is often hard to explain and justify. I will try now to give you some sense of the significance of our research and technology base.

Broad Goals of Research and Exploratory Development

The goals of research and exploratory development must be formulated from two perspectives: long-term gain, consistent with the nature and direction of scientific technological progress; and shorter-term matters of concern to our national security. Stated in the jargon of the investment business, we must maintain a basic portfolio of growth securities, devote a small fraction of our resources to high-risk but promising speculative ventures, and maintain a capital reserve of technical competence adequate to cope with unexpected technological threats or opportunities as they arise. Neglecting any one of these could jeopardize national security. The greatest overall security obviously lies in an optimum balancing of available resources. It is difficult to know how precisely when that balance is achieved.

For the long term, we seek to probe the frontiers of defense-relevant science and engineering, to discover and understand new phenomena, to recognize and exploit those which have promise for improved military technology. Thus, we support research in the laboratories of DOD, universities, industries, and the Federal Contract Research Centers. From these laboratories have come radar and rockets, transistors and television, combat radios and computers, sonar and satellites, and a host of indispensable military systems. Because a technical surprise today could unpredictably destabilize the international situation, our program must be broad and carefully diversified to allow us to move quickly in any required direction.

Nature of Soviet Technology

To suggest the character of the technical challenges we may face in the future, I believe it will be helpful to illustrate briefly some of the areas in which we believe the Soviet Union is particularly active. I do not introduce this perspective because of any anxiety that the Soviet Union is, technically, "10 feet tall." Nor do I believe we are on any "technological plateau," as some have argued; the facts show that we are not. But I do want you to understand that the Soviet Union is an advanced and vigorous technical nation, investing proportionately more of its scarce resources in research and development than we are, and presumably getting results from its investment. Except where I indicate otherwise in this discussion, few of the Soviet efforts represent substantially greater capability than we now possess, although in many areas we probably are about even.

The Soviet effort in magnetohydro-

Dr. John S. Foster Jr.

dynamics is the largest in the world. Two prototype continuous open-cycle electrical generating power plants are now in operation in the USSR and the Soviets are developing a closed-cycle system. The latter could have strategic applications in submarine and in space propulsion.

Although the Soviets have not fully exploited their strong capability in semiconductor research in the past, the use of solid-state devices in the consumer, industrial and military fields is rapidly becoming a reality.

Microelectronics has not been widely applied in the USSR, although progress has been rapid since 1962. Miniaturization has not advanced much beyond the employment of compact transistor circuits and is achieved principally by high-density packaging of discrete components on printed boards. Large-scale use of microelectronics appears to be several years away; its initial use will probably be in large digital computers in 1970–71.

Development of radar antennas has paralleled that of western countries, current emphasis being placed on a wide variety of microwave antennas for general and special uses and on large, multibeam, electronically steerable phased arrays.

The Soviet Union has expended a

massive effort to develop, produce and install active infrared sensory devices. By 1975 low-light-level image intensifiers should be available for widespread use in the Soviet Union.

Since 1962, the Soviet laser program has been expanding and is now second only to the United States in their overall research and development effort. The USSR may be ahead of the United States in the development of high-power, solid-state lasers.

The Soviets will probably continue their underground nuclear tests, just as we will. These tests will allow them to develop improved fission and thermonuclear weapons tailored for special uses and to explore weapon systems vulnerability to nuclear radiation.

There have been and will continue to be strong Soviet efforts to improve the performance—and increase the time between overhaul—of their rotating (turbojet, turbofan) aircraft engines. This emphasis will result in new and improved engines, such as the capability to qualify a Mach 3 cruise turbojet by 1969–70, and lift/cruise and direct-lift engines with very good thrust-to-weight ratios by 1970.

Soviet liquid-propellant rocket engines in some ways are distinctly different from those of the United States, as reflected in larger expansion ratios, higher chamber pressures, different materials of construction and better control of combustion processes. The Soviets have the capability to build and utilize much larger liquid-rocket engines for space purposes than they have heretofore exhibited. For ballistic missiles, no completely new liquid-propellant engine designs are expected before 1972. However, as a result of concerted efforts beginning in 1958, the Soviets are capable of building solid-propellant motors having performance characteristics similar to those of the West.

Soviet capability in materials and manufacturing technology has developed surprisingly fast and is now generally equal—in some instances, superior—to that of the western world. Difficulty in achieving the high standards of quality control necessary for the quantity production of highly precise and highly reliable components appears to limit Soviet production capability at present; however, it is expected that this problem will be solved in the next two or three years.

Some of the areas in which the Soviets seem to be advanced are chromium-base alloys for long-time operation at 1,900 degrees to 2,200 degrees F., high-temperature adhesives, high-temperature polymeric coatings, use of glass-reinforced laminates, techniques and machinery for fabricating brittle materials and difficult shapes, and machinery for extruding and forging large metal parts.

Allow me to repeat that these Soviet technological programs have not *eliminated our margin of technical* superiority in most of our systems. Nevertheless, the range, pace, and apparent quality of their work in the fundamental sciences and applied technology are impressive.

Trends in DOD Research and Technology Base

The past fiscal trends in our research and technology base are shown in Figure 1.

Despite the increasing complexity of defense technology and the increasing costs of carrying on more demanding research and development, support for our overall research and technology base has continued to decline. We reversed the downward trend in the research category in FY 1969, based in part on my special concerns about this activity last year. But the overall trend of our base is still downward, because of both the increased cost of research and development and the continued erosion of exploratory development owing to urgent needs for funding other research and development activities. We continue to see the indicators of significant under funding in this program: an increasing ratio of acceptable proposals to funded proposals; deferral of purchase of needed new research equipment in many academic and industrial research laboratories; lay-offs of technicians and postdoctoral research fellows; and too few "new starts" because of the pressing need to continue existing projects.

Continued failure to reverse the trend of this critical part of defense research and development could seriously jeopardize our future national security. Thus, I have requested increases for both areas in FY 1970, including an especially substantial increase for exploratory development. I will discuss each area and give you my recommended funding.

Research

Research Objectives and Policies

Within the broad goals of our research and technology base, the research component works at the frontiers of knowledge in the physical, engineering, environmental, biomedical and behavioral sciences, emphasizing *fundamental* work relevant to long-range defense needs.

DOD must manage a mission-oriented research base, as must (or should) all of the major agencies. Because the effectiveness of coupling basic science with defense technology is so vital and in many ways so subtle, DOD must recognize and direct responses to scientific and technological opportunities or threats. We could not rely upon an accidental occurrence of this critical function.

Recent Research Accomplishments

New scientific findings continuously emerge from DOD-supported research. Significant contributions have been made by in-house laboratories, industrial laboratories, non-profit institutes, and university research performers. I will give you just a few examples.

Global thunderstorm activity detection.

We are almost totally dependent on the electromagnetic spectrum for communication, detection of enemy activity by various types of sensors, missile guidance, and other military activities. Detailed knowledge of global *thunderstorm activity would increase the reliability of our electromagnetic* systems. We have found promising new sensors to obtain this global data through recording that spectral component of longest duration in lightning. The technique is being tested *on U–2 aircraft and appears to be* ideal for continuous surveillance by satellite. It is expected to be available for use within a year.

High-temperature lubricants.

A new technique for the fluorination of organic compounds and graphite has been developed by passing a mixture of fluorine and an inert gas over the surface of the compound to be fluorinated. For example, graphite can be converted to perfluorographite, which has lubricating properties comparable to currently used lubricants at normal operating temperatures

(400 degrees F.) and much superior to them at temperatures in excess of 575 degrees F. They will be especially useful in the bearings and seals of advanced jet engines.

Uultrashort laser pulses.

The range of defense applications of laser technology has been enlarged by recent developments in the production of ultrashort laser pulses. Pulses of less than a millionth of a microsecond in duration have been generated. The much more precise timing and distance measurements, possible with these very short pulses, promise important improvements in optical radar, laser communication systems, rapid optical data processing, and ultra high-speed photography.

These examples typify the thrust of scientific and technological achievements to defense goals.

Before leaving this discussion of specific, rather basic research efforts, I want to illustrate the way in which this work leads to applications. A good illustration comes from the materials sciences, in particular, composite materials. The promise inherent in filamentary materials was originally predicted from independent theoretical studies and independent university research on metallic whiskers. The fundamental objective of this work was to study why theoretical strengths could not be achieved in actual materials. While this work was interesting from a scientific point of view, it could contribute little to the materials used in military applications unless someone identified the connections between the basic scientific findings and DOD needs. Research managers in DOD, having just such a motivation, *i.e.*, that scientific findings can and must be put to practical use, recognized that these discoveries could help solve some military problems.

It was the requirement for stronger, lighter materials that caused the Military Services, as far back as the late 1940s, to make fine filaments, to study their properties, and to conduct research to improve them. Basic and applied research in the Air Force alone (which had the greatest need and interest) reached almost $3.5 million in FY 1966. This pursuit of a promising scientific finding led to an on-going advanced development program which will put composite materials into many Air Force and other military applications with substantial savings in weight, or increase in engine thrust, payload, range, or maneuverability.

Occasionally I am asked whether some of our more basic research could be carried out as effectively under other than DOD sponsorship. It is the kind of evolution that I just illustrated that convinces me the Defense Department must sustain clear and close links to the scientific community.

But then I am asked whether we tend to duplicate the work sponsored by other agencies. I am quite confident that there is essentially no duplication, except where there are distinctly different scientific approaches to solving the same basic problem. Last year, for example, we examined the work being conducted under 10 contracts sponsored by the National Science Foundation in the materials sciences. The total value of these contracts was about $500,000. It was determined that very little, if any, of the contracting work was directly germane to DOD mission objectives but that about 10 percent (or $50,000) could be considered relevant.

Let me give you another example of the coordination process we use to avoid duplication. DOD and NASA have conducted annually a detailed review of all research and exploratory

Trends in Research and Technology Base

($ in millions)

	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	FY 1969
Research	$ 353	$ 383	$ 389	$ 418	$ 371	$ 406
Exploratory Development	1,158	1,128	1,134	1,042	948	878*
TOTAL	$1,511	$1,511	$1,523	$1,455	$1,319	$1,284*

*The reduction in FY 1969 (compared with FY 1968) includes a $45 million reduction in which these funds were transferred from the Advanced Research Project Agency's exploratory development effort on ballistic missile defense to the Army's advanced development effort on missile defense. The nature of the work supported has not changed in character. Thus, this was essentially an accounting change. FY 1969 funding is, in effect, $923 million, and the total is, in effect, $1,329 million.

Figure 1.

development projects in the biological, medical and life sciences at the individual work-unit level since FY 1965. Methods were developed to compile all related research work by subject matter which is then analyzed by DOD/NASA technical teams. Research efforts that might overlap are identified and subjected to a detailed review, and a joint decision is made on terminating a contract, if appropriate. Out of about 4,000 tasks reviewed recently, there were no more than six cases of even partial overlapping. This procedure has been very effective in assuring that no unwarranted duplication exists, ensuring that each agency has full knowledge of the scope and content of each others' research programs, and aiding the day-to-day coordination between agencies by the biomedical research program managers.

* * * *

Recommended Budget for Research

Following an in-depth review of the various levels and directions of research programs, I am recommending a total of $432 million for FY 1970. This increase provides for 25 new Project THEMIS programs, and for a 4 percent cost of living increase for the rest of the research activity. As I said earlier, this investment is for the future—this is the investment that will determine, in large measure, whether we maintain our technical superiority.

Exploratory Development

I will turn now to exploratory development, the second segment of our research and technology base.

The purpose of exploratory development is to demonstrate the feasibility and applicability of research discoveries to DOD needs. It is also the mechanism we use to ensure that each technological opportunity has a matching military utility, and that feasibility determinations are made in full realization of the anticipated use of the device or component. Thus, before we embark on expensive advanced or engineering developments of any weapon system, we use exploratory development to give us a high degree of confidence in the technical feasibility of the system.

Past studies have shown that new systems that are markedly improved over their predecessors frequently are made possible by the aggregation of many component improvements. This aggregation and eventual proof of feasibility may take as long as 10 years to become operational in a finished system. Thus, we must attempt to predict our military needs in advance, well ahead of firm official requirements. These predicted needs can change in many directions, including changing enemy technical threats. To guard against serious technological surprise, we have a broad exploratory development program to provide a choice when our needs become clearer and our optimum response more firmly defined. This is one of two main reasons why we have thousands of exploratory development projects.

The other main reason for a broad program is that the development of a system to meet one operational goal often leads to an array of many difficult technological problems and projects. Let me illustrate this.

The Vietnamese War has clearly demonstrated the high cost of flying aircraft directly over well-defended targets. For such purposes it is becoming increasingly necessary to deliver tactical ordnance from a stand-off position, *i.e.*, outside the range of the defensive systems. Stand-off ranges of 20 to 30 miles would be adequate today, but longer ranges will be required in a few years. A closer look at this requirement reveals two most demanding sub-requirements. First, since this type of missile is not intended to deliver high-explosive ordnance, it must hit the target within a few feet. Second, since the weapons effect is relatively small, the cost of the system must be low.

Achieving this one new, comparatively straightforward operational capability—stand-off, low-altitude delivery of high-explosive ordnance—has required major improvements in guidance and propulsion. Of these, let me illustrate how the propulsion problem alone fanned out into a range of tasks for new technology.

There are at least three distinctly different types of propulsion systems that had to be explored to achieve the earliest possible capability and, eventually, the highest possible performance. They are first, a pulse-type solid rocket, which appeared to be the most readily available; second, a ramjet with integrated booster; and, third, a high-density solid-fuel ramjet with integrated booster, which appeared to offer the higher performance, the range ultimately desired.

Each of these types, however, involved a whole series of technological problems. For example, to achieve a stop/restart capability in solids, several methods had to be investigated: water quench, variable-area nozzles, secondary gas generators, and inhibiting partitions. Exploratory tests of all of these methods were run and, for this application, inhibiting partitions appeared to be the simplest and most readily achievable. But, to keep the area of the inhibited faces small, the burning rate of the propellant had to be increased which involved the development of new burning rate catalysts and higher chamber pressures. The new catalysts required the development of new liner materials, and the higher chamber pressures raised the erosion of nozzle throats and imposed increased pressure loads. These effects led to the required development of new nozzle materials and new methods of bonding the propellant to the case. In a similar manner, the solid-fuel ramjet posed a whole series of new technological problems. A new grain formulation which would yield a fuel-rich, highly combustible exhaust had to be discovered and developed. Its combustion efficiency had to be measured under simulated ramjet combustor conditions, and an aft inlet had to be worked out for use on a missile maneuvering at high angle of attack.

The point which I wish to make here is that, to achieve this single new capability, it has been necessary to pursue three options, each requiring solutions to a series of technological problems. This is typical of how our exploratory development program evolves. In this case, all of our efforts have paid off, and the solutions obtained in the process have created a background of knowledge applicable not only to air-launched propulsion, but to surface-launched tactical and strategic systems as well. I am confident that, had we tried to achieve this operational capability without the necessary technological base, the consequences would have been a far greater development expense and the serious compromise of system performance.

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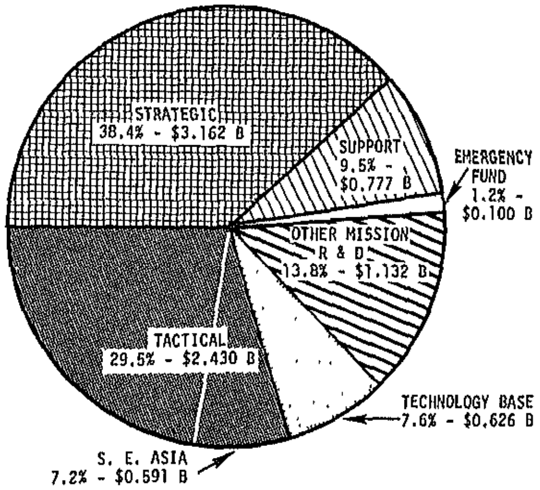
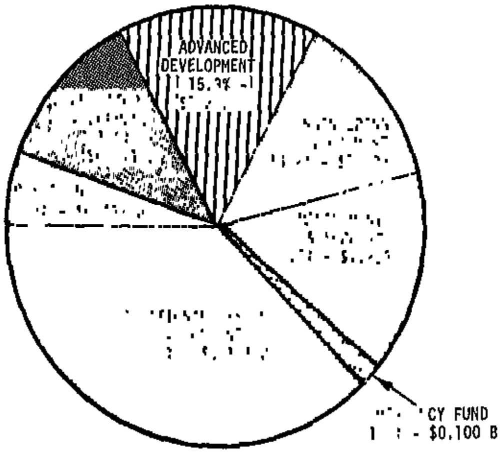
($8.227 Billion)



Mission Distribution



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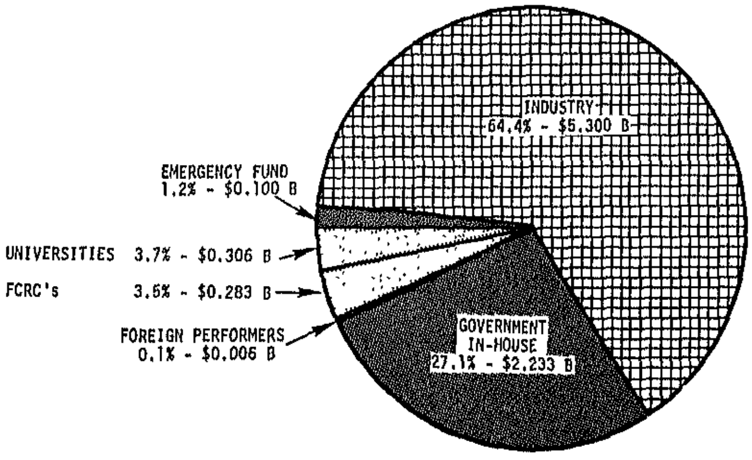

Performer Distribution

Recent Contributions of Exploratory Development

The exploratory developments of the past few years have made many significant contributions to our military capabilities. The three initial conditions that must exist before we embark on any exploratory development project are: first, some understanding of the physical phenomena involved; second, one or more clear concepts about how these physical phenomena can be harnessed to perform some function; and third, really most important, that we see a general need for this function, whether new or improved. I would like to illustrate these points.

During the early operational phases of the Polaris submarines, the Navy recognized the operational advantages of achieving greater depth and speed. Thus, in 1960, the Navy began efforts to develop a higher strength steel for submarine hulls, stronger than the steel then available for Polaris submarines. During the period from 1960 through 1968, the Navy spent about $6 million on exploratory development of high-strength steel.

When the Soviet submarine threat became clear in 1967–1968 and the decision was made to proceed with development of advanced nuclear attack submarines, the technology of the desired steel was sufficiently un-[illegible]rstood to embark on an advanced [illegible]velopment program. This program [illegible] timed so that the high-strength [illegible]eel can be qualified and certified for [illegible]e on this new class of submarines.

This capsule history brings out an [illegible]portant point. When the developm[illegible]ent of the new steel was started in [illegible]0, no firm "requirement" existed, [illegible] a clear, though generalized need [illegible]s anticipated. Had we waited for [illegible] firm and detailed requirement, the [illegible]terial would not have reached a [illegible]fficiently advanced stage of developm[illegible]nt in time to be used for the ad[illegible]nced nuclear attack submarine.

[illegible]o complete the history to date by [illegible]ntifying the effectiveness of the [illegible] steel: For ships having substan[illegible] the same length, displacement [illegible]ed, the maximum operating [illegible]an be greatly increased by [illegible]e stronger steel. More ad[illegible] steels and titanium alloys, [illegible]re now in exploratory devel[illegible] would enable operation at [illegible]ater depths.

Let me say a few words about titanium. The titanium industry is a direct consequence of DOD sponsorship of exploratory development. Starting about 1948, the Army, Navy and Air Force established a substantial coordinated research and development application effort on this metal. The impetus for this work was recognizing the potential of titanium alloys, which have high corrosion resistance, to become the strongest metallic structural materials known in proportion to their weight.

In 1968, the United States produced 33 million pounds of titanum. Titanium alloys are used in both military and civilian aircraft as structural members and in the compressor stages of the engine. Without titanium, the supersonic transport would not be capable of meeting its operational goals. The metal is also to be used in submersibles because of its lightness, strength and corroion resistance. Its corrosion resistance has put it into such civilian applications as food and chemical processing. Uses in the near future will include desalination plants and steam power-generating equipment as well as equipment for the transportation industry. By 1978 it is estimated that 100 million pounds of titanium will be used. Our new aircraft will be able to reach their required performance in part because years ago we stimulated the developments which made titanium alloys available today. DOD has profited, but so have many American industries and our whole national economy.

To return to the main theme, let me give another current example of melding technological opportunity with military need. Our night combat efficiency in Southeast Asia has been spectacularly improved with the introduction of night vision devices. Continuing support for the night-vision exploratory development programs is responsible for this achievement. Direct payoffs from the program, as many of you realize, are the Starlight Scope for individual weapons, a night vision goggle for use by individual soldiers, and night vision devices for crew-served weapons and aircraft, such as thermal night sights for our antitank missile systems and night fire-control system of advanced helicopters.

* * * *

There are other examples of products from exploratory development that have proved highly effective: the antifungal treatment to prevent infection from water immersion, laser-guided weapons, some of the sensors for the instrumented battlefield, an oxygen concentrator to replace LOX for pilots, second-generation night vision devices, foliage-penetration radars, flechette-type weapons, and miniaturized high-reliability fuzes. There are many others, such as ceramic personnel armor, transparent armor, "soft-recoil" artillery weapons with greatly reduced weight, a crashworthy fuel system for UH–1 helicopters, a plasma-deposited tungsten composite rocket nozzle which will operate uncooled at flame temperatures of 6,500 degrees F., an air cushion landing system for aircraft, improved binary chemical munitions which do away with storage and shipment hazards, and free-swimming divers attaining 1000-foot depths.

Further enumeration of such examples, valuable and exciting as they are, would become tedious. A catalog of these accomplishments is important, in a sense, because we see clearly what we get from our investment. But what is more important is that, year after year in the past, our research and technology base consistently has given us new opportunities and new options. We must support our technological effort so that, in the future, we will have comparable technical opportunities and choices. For it is in exploratory development that the U. S. technical advantage, the U. S. margin of technical superiority, is strengthened.

Recent Trends

The demands placed on our exploratory development program have increased considerably over the years. Many additional projects are necessary to support the varied technological problems inherent in new, sophisticated weapon systems. Yet, as we face the decreasing level of funding, some necessary programs are being pushed aside or reduced in favor of higher priority efforts. In FY 1964, the exploratory development program was funded at almost $1.2 billion. In FY 1969 it had declined by over 25 percent to $878 million. If, in addition, we take into account the increase in the cost of performing this work, then our actual FY 1969 effort is only

slightly over half of the effort active five years ago.

If this trend continues, we will be forced to reduce our level of effort in projects having even higher relative priority in our program. Our ability to meet known threats will be compromised, and we will lose urgently needed options for potentially needed future developments.

I cannot reemphasize too strongly that we must increase our forward momentum in replenishing the reservoir of science and engineering upon which national security depends. This conviction has been validated so often that it has become our guiding principle in the support of our technology base. The decade of the 1970s will reveal the results of the impressively growing Soviet and Chinese technical programs. We surely do not want to be technologically stagnant so that a slight technological advantage or surprise could have historic implications.

I am aware that some have argued that a large DOD program in exploratory development may be justifiable but so poorly coordinated with other large Federal research and development programs that funds are wasted. In particular, for example, some people have asked whether the coordination with NASA is effective. As I mentioned in discussing the research budget, we try hard to discuss our entire program with NASA in several ways through several mechanisms throughout the year. Last summer for instance, the Secretary of Defense and the Administrator of NASA directed a special series of joint "economy studies." These detailed studies cover a number of common DOD/NASA activities in the space and aeronautics areas directed toward identifying actions which can lead to savings. So far, I am impressed with the progress. While significant near-term savings have not been possible, a number of approaches that could lead to significant long-term savings have been identified. The most promising areas are networks (tracking and data acquisition), launch vehicles, and support operations at the Kennedy Space Center and the Eastern Test Range. . . .

Budget Recommendations

We have reviewed every proposed technology program, have related them to priority defense needs, and have totaled the funds necessary to accomplish the overall program. On this basis, I am recommending that $970.5 million be allocated to exploratory development, compared with $878 million in FY 1969. This will reverse the recent trend, accelerate promising current programs, and permit the start of necessary new programs. I urge you to support this increase.

The Advanced Research Projects Agency

I have already referred in other parts of my statement to recent research and exploratory development in which the Advanced Research Projects Agency (ARPA) has made a major contribution, notably in strategic technology, nuclear monitoring, overseas defense research, and advanced sensors.

Now we should discuss briefly the role of ARPA in our overall research development, test and evaluation (RDT&E) establishment and mention some other ARPA accomplishments. These accomplishments include technical advances as well as several areas of management changes in the transfer of programs to the Military Services.

ARPA, as you know, was established in early 1958 in response to a need for centralized management of selected, high-priority projects. In the past 10 years, ARPA has proved to be extremely effective in handling projects in which feasibility demonstration is essential to DOD, but for which there is no clear Service mission; projects that are multi-Service in nature; and projects that require an especially quick reaction. Because ARPA's primary mission is ensuring DOD against technological surprise, it must search out new fields and ideas, accelerate research and development where surprise could be critical, and bring developments to a stage at which sound decisions can be made on their further exploitation.

It is ARPA's objective to carry programs to a certain stage in research or exploratory development, and then transfer them to an appropriate Service. This past year, the radar and interceptor technology programs of ARPA's ballistic missile defense project (DEFENDER) were transferred to the Army Advanced Ballistic Missile Defense Agency (ABMDA) in consonance with the latter's Nike-X research and development responsibilities. To ensure the successful transfer of the programs and facilities, approximately $45 million in FY 1969 funds and appropriate staff were also transferred. After a review of the strategic research and development field, a Strategic Technology Office was created within ARPA to pursue a broad program of research and development designed to identify, explore and demonstrate advanced concepts and technology that could have major technical impact on the offense/defense balance—hence, on the U.S. strategic capability. One of the major areas assigned to the Strategic Technology Office is laser technology. Selected areas that were inappropriate for transfer to ABMDA were assigned to the Strategic Technology Office to provide the technical core for its new activities. The transfer is judged successful by all concerned.

A new area to be undertaken by the Strategic Technology Office in FY 1970 is research and development in large sea-surface platforms. The objective of this program is to demonstrate the feasibility of large, ultrastable floating platforms adaptable to a wide variety of functions at sea, including forward basing (in addition to, or instead of, foreign-based installations), surveillance, logistics, ballistic missile defense, and tactical command and control.

During FY 1969, ARPA established another new program—advanced engineering. Its major objective is to explore new areas of advanced engineering for selected tactical warfare problems. These problems include the development of quiet aircraft and helicopters, and developing new concepts in small arms. Included in this program's research plans for FY 1970 are the investigation of a low-cost, lightweight flying machine (perhaps less than 50 pounds in weight and $500 in cost) which could be used for individual troop mobility, and a surface-effect vehicle in the 100- to 200-knot class which would have potential in anti-submarine warfare and high-speed patrolling.

Another of ARPA's projects reoriented in FY 19[illegible] formerly called N[illegible] tion (VELA), now concerned with n[illegible]

prediction of the location of clandestine nuclear tests, countermeasures to capabilities and techniques previously developed by the VELA program, and diagnostic data on nuclear explosives. These new programs have been entitled "PRIME ARGUS." A substantial phasing down in the older, on-going VELA program concerned primarily with nuclear test detection will take place during FY 1970.

In FY 1970, a Military Geophysics Program will be started under the newly formed Nuclear Monitoring Research Office, which also manages VELA and PRIME ARGUS, to demonstrate the feasibility of countering threats to the national defense posture posed by the modification of the natural environment. The program will try to determine the extent to which underground nuclear explosions can stimulate earthquakes; the extent to which man's non-nuclear, defense-related activities can stimulate earthquakes; and, finally, the feasibility of techniques that might permit control of earthquakes. Because of the great national interest in this field, we will arrange for intra-agency consultation on all major elements of the program.

ARPA has three projects that are funded in the research category: Information Processing Techniques, Behavioral Sciences, and Materials Sciences. In each of these projects, a major portion of the effort is conducted for ARPA by universities. We have attempted to provide these institutions with a funding mode that will permit them to make the required commitments for staff, facilities, students and university funds.

ARPA Projects in FY 1970 Budget

($ in millions)

Research	
Materials Sciences	$ 17.3
Behavioral Sciences	5.4
Information Processing	25.9
	$48.6
Exploratory Development	
Strategic Technology	$ 71.7
Nuclear Monitoring	88.5
Overseas Research	29.4
Advanced Sensors	20.5
Advanced Engineering	13.1
Technical Studies	7.8
	$189.5
TOTAL	$238.1

Figure 2.

In the past year, ARPA's Information Processing Techniques project has completed research on a computer software system for data management; ADEPT (the operating system) and TDMS (a set of user-oriented data management programs) will permit far more rapid and effective computer operations than were possible in the past. Already in trial use in the National Military Command Center and the Air Force Command Post, ADEPT makes it possible for many users to have simultaneous access to the computer, and incorporates such advances in file organization that requests for computer services which formerly took hours to fill may now be answered in minutes.

In the behavioral sciences area, research is being continued to organize information pertaining to foreign cultures in order that military and civilian advisers become more effective in communicating with people of other nations. For example, a technique known as the Cultural Assimilator has been developed. This technique employs a set of programmed teaching materials on a country's culture and seeks to improve an individual's cultural sensitivity to an area he visits or to which he is assigned. The Cultural Assimilator is proving to be effective in aiding the performance of DOD personnel in a foreign environment. Thailand and Iran are among the countries for which Cultural Assimilators have been prepared.

Recent fundamental research on penetration mechanics supported by ARPA's Materials Sciences project has pointed the way to new approaches that may lead to the capability of providing adequate protection for the infantry soldier with a considerable reduced weight penalty. These research findings are being made available to the Army for exploitation. Recent work in explosive forming technology has resulted in substantial advances in the fabrication of large shapes. For example, single-piece domes are currently being produced by this technique for the Sprint missile.

In FY 1970, the Materials Sciences project will start an intensive investigation of properties of rare earths and other exotic materials, with the expectation that certain of these materials will lead to great improvements in magnetic and semiconducting devices. Effort is continuing to increase the relevance of the fundamental research in the Interdisciplinary Laboratory (IDL) Program to DOD needs. A large number of IDL researchers began regular visits to DOD laboratories during the past year to assist in the solution of DOD materials problems.

ARPA has six projects funded in the exploratory development category: Strategic Technology, Nuclear Monitoring Research, Overseas Defense Research, Advanced Sensors, Advanced Engineering, and Technical Studies. . . .

In 1968, ARPA continued to make quick-response research and development contributions for Vietnam through its Overseas Defense Research and Advanced Sensors projects. To highlight two especially important efforts, ARPA continued its progress in counterinfiltration and intrusion detection technology. At the request of the U.S. Commander in Korea, ARPA undertook a system design study of the infiltration problems facing the Republic of Korea.

In Thailand, ARPA is working as a member of the Country Team carrying on systematic research and development on how to deter insurgency. Every project is approved in advance by the Thai government and by the U.S. Ambassador. With their approval, we work closely with the Thai government. For the past two years, ARPA has conducted a system design and test program. The resulting pilot system designs have been carried through the final phases, and the Thai government is taking over further responsibility. ARPA has also provided technical assistance to the Thai government to develop a boat hull for patrol vessels suitable for the shallow, rocky Thai waterways. The Thai government is now proceeding with the development of the hull entirely on its own.

ARPA's Technical Studies project provides specialized scientific, technical and engineering support to the

rest of ARPA and to my office. The effort is generally in the form of short-term investigations of major problems, often of a quick-response nature, covering the state of the art of a given technology, or reviewing alternate solutions to technological problems facing DOD.

Our FY 1970 budget request for ARPA totals $238.1 million. This includes $48.6 million for research and $189.5 million for exploratory development divided among the projects as shown in Figure 2.

Topics of Recent Special Interest

In this section I will discuss some topics that have been of recent special interest to the Congress. For each I will give a short assessment of the situation.

Development Concept Papers

I will discuss the overall policy framework for research and development management in a moment. But first I want to give you a progress report on a new "discipline" for research and development management on major programs. I am quite satisfied with the initial impact of this new discipline which is imposed through Development Concept Papers (DCP).

A DCP is a summary top-management document for the Secretary of Defense which presents the rationale for starting, continuing, or stopping a development program at each critical decision point. It assesses the known risks involved in each decision, along with the full military and economic consequences of the program, and lays out explicit decision-review "thresholds" for key factors, such as technical performance, cost and schedule. In short, a DCP tries to minimize biased "advocacy" points of view and to state clearly all of the known uncertainties involved in major decisions on research and development.

We have had more than a year's experience with this approach. Since late fall 1967, we have prepared 81 draft DCPs. The Secretary of Defense has personally signed 25 involving more than $12 billion in funding over several years. The others were either approved by my office or returned for further work now in progress. In a few cases we are in the second cycle of revising and updating a DCP for the Secretary's review.

While we have found it difficult to prepare a single, succinct, analytic document for the Secretary which contains all of the issues—and all the pros and cons on each issue, the new process is genuinely effective. The work of preparing a DCP is remarkably valuable in itself, because it forces a dialogue—usually rather objective—among all the key people interested in decisions on major research and development programs. To ensure that the system continues to improve within certain ground rules, we are now drafting a DOD directive on the process.

Research and Development Management Policies

For many years and especially during the last few months, there has been much discussion on the management of defense research and development. Some of this discussion and the resulting publicity have been quite critical, pointing to specific cases (past and current) in which our goals apparently were not achieved or in which our management allegedly was not adequate. I want to discuss these issues and problems with you briefly, broadly and candidly, and I will be happy to try to answer any specific questions you may have.

Let me begin by restating the major criticisms. Some have said DOD has no effective ways to control the costs of major development efforts—and the C-5A transport aircraft development and procurement has been singled out to "prove" this charge. Some have said we start programs long before the required technology is available—the SRAM bomber missile development has been used to support this charge. Some have said we agree to unreasonably optimistic schedules for development efforts—the delays encountered in completing development of the Mk-48 torpedoes have been cited as demonstrating this failure. Some have said we do not carry out a sufficient number of competitive prototyping efforts, and for this reason we fail to achieve reliable results in advancing the state of the art—a series of electronics programs during the 1960s has been "analyzed" to "prove" this charge. Finally, some have said we tend to reward the least efficient contractors with follow-on contracts and to grant unreasonably high profits to most contractors.

If none of these charges were in any respect valid, we would simply be the targets of irresponsible criticism. If this were the case, we would not be concerned, although we would have to improve our communications. But the facts show that each criticism contains some element of truth, unfortunately along with a much larger element of misinformation and distortion. Further, the facts show that DOD has been concerned *and active* in solving the management problems revealed in the past. Overall, defense research and development continues to be complex, costly and (most important) central to our national security. Thus, research and development management has been a prime concern of past Secretaries of Defense. While I am primarily and continuously responsible for research and development management, it also holds the first-priority attention of Secretary Laird and Deputy Secretary Packard.

Let me now outline what I regard as the basic issues underlying defense research and development management, and trace briefly the history of changing management approaches.

There are many approaches to acquiring weapons. We can concurrently develop the system in the laboratory and prepare to produce it. We can develop prototypes first so that we can "fly before buying." Or, we can buy items that have been developed at the supplier's risk and are on the shelf.

Over the past 20 years, we have seen different strategies for using these options. These strategies have been shaped as much by the national objectives and priorities then current, as by technical possibilities and management policies. Throughout the 1950s, the Soviets were presenting many challenges and rapid improvements in their strategic nuclear forces and in the conventional arms with which they threatened NATO. The Iron Curtain amplified our uncertainties concerning their objectives and their progress. The rapid and continuing progress in electronics, aircraft, missiles and weapons provided almost unlimited choices and unlimited potential threats. Given these great uncertainties in threat and technology, we had to take risks and pursue multiple and parallel approaches. We could not risk the delays inherent

in the idealized sequence of developing and then testing laboratory models, then developing and testing prototypes, and then building production versions. National objectives dictated concurrent establishment of production facilities in anticipation of the successful development efforts. Letter contracts were awarded before specifications were fully completed. Competition for programs often could be judged only by evaluating broad technical approaches and organizational competence. Compensation was based on costs.

The management consequences of these approaches were generally well understood from the beginning. However, by the 1960s, the results and shortcomings were beginning to emerge.

For example, a Harvard study, in 1962, carefully examined the development of a number of major systems: five air defense missile systems, one candidate ABM system, three supersonic aircraft, and three ballistic missile systems. The study concluded:

- All but one of these systems became operational and satisfied the goals that had evolved during the development of the programs.
- The systems required development times on the average at least a third greater than the initial schedule—in several cases, twice as long.
- The systems required increased development funding averaging three times more than the initial estimates—in one case, seven times greater.

By the 1960s, Government and industry had learned a great deal about the development of major systems. Moreover, the successes of the programs of the 1950s gave us a position of clear strategic superiority that permitted a change in the urgency and character of national objectives. We were, therefore, in a position to stress a much more deliberate approach to each phase of exploration and acquisition.

Our purpose was to reduce the costs to the Government of major systems acquisition. As you know, the only way to reduce cost without reducing profit is to reduce the risks and cost of manufacture. Therefore, we introduced the philosophy and procedures of concept formulation and contract definition. With this philosophy, new emphasis was placed on thorough reviews of need, feasibility, performance, schedules and costs. Before a major development could be started, DOD insisted on a demonstration that technology was available and on an explicit analysis of precisely what was expected from the investment. When it was decided to acquire a new system, an attempt was made to achieve fixed-price competitive contracts wherever possible.

Concept formulation defines the mission and performance goals of the new system, after a thorough evaluation of the costs of alternative means of satisfying the military requirements. It examines many technical alternatives to select the best technical approach. It seeks to ensure that the effort has reached a point where the needed technology is available and proved, so that no further substantial experimental effort will be required. Concept formulation analyzes the estimated cost, effectiveness and schedule for development of the proposed system to ensure that it compares favorably with all other similar and competing systems.

After all advanced development work is completed, we start contract definition. It is a competitive process designed to verify the completion of concept formulation and to establish realistic, firm management plans. Contract definition culminates in a signed contract, based on the expectation that the system will be produced and go into the operational inventory.

Several major weapon system developments have now been carried through using the program management philosophy and procedures formulated in the early 1960s. Some of these systems will shortly be entering the inventory. It is, therefore, timely to call for a deliberate examination of the results of that philosophy and to extract the lessons in our recent experience. Any management approach tends to be evaluated more by its failures than by its successes. Each of us has impression of the impact of concept formulation and contract definition. I would like to outline our tentative views on the experience of the 1960s.

Our reviews are not yet complete. Cost overruns, schedule slippages, and drifting concepts are still with us. However, it is clear that the systematic application of concept formulation and contract definition *has* resulted in a significant reduction in cost overruns and schedule slippages.

Typical increases in actual system costs have been on the order of less than twice our initial estimates rather than three to seven times greater, as documented in past studies. Often these overruns have seemed larger to you and to the public because the costs publicized originally were the minimum target and did not include recognized incentives and contingencies. In short, we believe cost controls have, in fact, improved. Most increases in cost recently have been the result of an explicit decision to develop a better product using newly proved technology.

Representative delays in introducing operational systems into the inventory, over the dates scheduled at the time of contract definition, appear to be reduced from the delays common during the 1950s. Systems concepts and specifications also seem to be drifting much less from contract definition to deployment than was true for the major systems developed in the 1950s.

This system works best where only straightforward engineering efforts are needed after the decision to enter production. When we simultaneously set a schedule for production while complex and risky development remains to be accomplished, we usually find that we are forced into a concurrency of production and development that compounds our problems. Unfortunately, in too many cases, the desire for a fixed-price contract before the risks have been reduced has placed a dangerous premium on optimism. On occasion, it has strained the technical integrity of both Government and industry.

We have learned that paper design studies, and even extensive analysis and simulation, are essential. However, studies alone cannot always produce an adequate basis for selecting an effective design and laying out achievable schedules, performance and cost. In some cases it is essential that we reduce critical subassemblies or components to hardware, often on a competitive basis, in order to gain adequate assurance of feasibility and design stability. Where the system integration is itself a major source of risk, complete prototypes may be mandatory. Where development costs are small in comparison with acquisition and operating costs, the added costs of competition in hardware may well pay off in total economy. In general, where the total research and development cost represents only a few percent of the total systems cost, competitive prototyping is wise; and

we will continue to follow this practice, perhaps in more situations.

In general, the key to sound defense research and development management is deceptively simple: Our objectives on each program and the way we choose to manage it must be clearly and explicitly stated and then fully debated, especially on the largest programs. We must assess deliberately the threat we face, the national goals, the urgency of solution, the status of the concept and technology, the capabilities of industry, the options avaliable, the costs, and the competing national priorities.

It is a major objective of the new Administration to review our experience and policies on research and development management, and to make sure we benefit from the wisdom we can collectively bring to bear on this subject. We must bring the perspectives of industry, Government and science into new reviews of the experience in the 1960s. We have, therefore, started major reviews by all appropriate senior military and civilian officials of DOD and by major independent advisory groups.

In particular, we have started work by independent analysts and managers from the Defense Industry Advisory Council and the Defense Science Board which advise the Office of the Secretary of Defense. We have also begun detailed supporting assessments which should be completed by this summer. We expect to make any changes in our management practices shown to be needed.

I hope it is now clear that we are aware of the trends and the deficiencies in defense research and development management. Frankly, I believe we have made substantial improvements. We can and will improve it further. I welcome your suggestions on areas which, in your judgment, require special emphasis.

* * * *

Security Policy on Technical Information

Questions have been raised during the past year about what some consider to be the large volume of valuable but unclassified U.S. military technology disclosed in open publications and, thus, made freely available to potential enemies. The Defense Department fully appreciates this concern to make sure that information requiring protection in the interests of national defense and foreign policy is adequately safeguarded.

Thousands of DOD scientific and technical personnel must determine each day what specific information needs protection and what does not. The basic dilemma in these decisions is, on one hand, to encourage the maximum interchange of technical information within the scientific and technical community of the Free World for our own benefit and yet, on the other hand, to minimize any free technical assistance to countries whose interests may not coincide with ours.

I believe there is general agreement that the single best method of protecting important military technical information is the use of proper security classification. As a general requirement within the DOD, information—and here I am quoting the formal definition—"the unauthorized disclosure of which could be prejudicial to the defense interests of the Nation" must be classified. We have what I consider to be a solid policy to provide technical classification guidance to personnel at all levels within DOD to help them make the decisions on classification.

You must understand that the U.S. technical community depends heavily and thrives upon the process of open debate. Without debate in most critical areas of defense research and development, our current technical superiority would be jeopardized, just as surely as it would be if classified information were compromised.

Nevertheless, because of our continuing concern that DOD policies and practices do the best possible job of safeguarding technical information, we have been reevaluating all directives and procedures concerning this responsibility. The purposes of this reevaluation are to ensure, first, that the intent of Congress as expressed in relevant statutes is fulfilled; second, that procedures for identifying and safeguarding information that requires control are effective and as simple in application as possible; and, third, that the public and the scientific and technical community have free access to all information that does not qualify for protection under security directives or under other criteria established by law. This reevaluation is currently in progress.

In-House Laboratories

We have 80 in-house laboratories spending about $1.8 billion in RDT&E funds, split about equally between our in-house projects and the contracts managed by in-house technical staff.

Changing Role and Structure.

In the past, we have had many individual laboratories but no effective system for integrating them within DOD in terms of major problem areas. Our organization has been fragmented along relatively narrow technological areas and, as military needs arose, few organizations were capable of examining the total problem. Thus, we have placed emphasis for several years on building larger aggregations with broader responsibilities, a broader view of problems, and with the range of specialized competence to solve each subproblem.

As examples, within the past two years we have closed three smaller laboratories and have consolidated 16 others into 6. The Army is now planning to consolidate 14 small activities concerned with research and development on nuclear effects into 4 larger groupings, as a first step toward a single "Nuclear Effects Research Center."

These new arrangements have permitted the laboratories to play a more important role in critical systems efforts, such as threat analysis and development of requirements; planning for future weapons; the assessment of the vulnerability of proposed major systems; coupling across the entire research and development cycle; and quick-reaction support for operational forces.

There are many cases which illustrate the importance of having effective in-house laboratories. I will mention one recent example from each Military Department.

- The tragic loss of the nuclear-powered attack submarine Scorpion led to a massive search by more than 40 ships and 6,000 men. After the initial search effort, the primary follow-up work fell to the USNS Mitzar and scientists and engineers of Navy laboratories. For nearly five months this team conducted a painstaking and arduous search which was finally successful. The success of this extraordinary task gives hope of determining why the Scorpion was lost.

Further, it is a major contribution to the Navy's programs in improved deep ocean search methods.

• An Air Force laboratory, during an exploratory development program, demonstrated an entirely new flight control system. The "fly-by-wire" flight control uses electrical wires between the pilot's control column and the control surface actuator, replacing the complicated mechanical linkage system now used in all aircraft. The system has been demonstrated in a B–47 flight test aircraft and shown to be technically feasible. This type of flight control system can reduce aircraft vulnerability as much as 50 percent, depending upon the type of aircraft and system configuration. It has been estimated that for the CH–46 and CH–47 helicopter a weight savings in the flight control system of 77 percent and 86 percent, respectively, would be realized by using fly-by-wire. Efforts are now being made to combine this development with another current development on integrated servo actuator packages for application to the F–15 aircraft. The new technique represents the first basic change to flight control systems since the days of early aircraft.

• Fires have been the biggest cause of death in helicopter crashes in Vietnam. Army laboratories have developed two approaches to reduce or eliminate this hazard. In the past year they have successfully developed a crashworthy fuel system for the UH–1 aircraft and an emulsified fuel which shows considerable promise. The crashworthy system consists of an improved ballistic self-sealing material for the fuel tanks, along with breakaway fuel lines that seal when the aircraft crashes. This system is expected to reduce fire fatalities by approximately 70 percent. By preventing rupture of the fuel systems upon impact, crashes that are survivable should not result in impact fires. These fuel systems will allow crewmen and passengers time to escape from the wreckage. First production UH–1 aircraft and retrofit kits will be produced and delivered in late FY 1970.

Environment for Quality and Productivity.

One of our key objectives for the in-house laboratories is to provide a degree of administrative flexibility equivalent to that of progressive industrial research and development organizations. To try to reach this goal I have had conscientious and sustained assistance from the Civil Service Commission. We have modified certain controls and regulations to meet the special needs of research and development organizations. . . .

We are providing the laboratory manager with the administrative tools to integrate his resources of people, program funds, facilities and equipment. Frankly, today this obviously desirable integration is extremely cumbersome. So we have taken a number of important steps to improve the situation:

• We have taken actions designed to solve 90 percent of the key 42 management problems identified last year in areas such as recruitment, career development and training, personnel mobility, and compensation. However, the manpower controls required by last year's Revenue and Expenditure Control Act (Public Law 90–364) have inhibited our ability to deal with a number of these problems as rapidly as we intended.

• We are planning a two-year experiment to test the hypothesis that the utilization of fiscal controls without numerical manpower controls is a better way to manage the laboratories. This experiment is based upon our view that the traditional numerical ceilings of manpower, imposed *in addition to* fiscal controls, inhibit the laboratories' ability to integrate manpower, dollars, facilities and work load. The Bureau of the Budget supports this experiment.

• The broader application of recent authority to match the salary offers of competitors has permitted DOD laboratories to become more competitive in recruitment. We have improved our ability to attract first-class people into leadership positions, by more rapid promotion and by infusion of new personnel drawn from industry and universities.

• A number of our new weapon centers, which I discussed last year, are operational, and their initial effectiveness validates the concept. Next year we expect to establish at least two more such centers.

• Greater fiscal flexibility has been needed for some time in managing exploratory development in the laboratories to meet new technical opportunities and to respond to urgent operational priorities. The Air Force now has achieved this with a single budget line item per laboratory. The Navy is restructuring its FY 1970 program to permit greater "block funding" to its laboratories. The Army is conducting a two-year experiment on single line item funding for three laboratories.

• Steps have been taken to facilitate the mobility of research and development personnel. The Navy has adopted a single job description for its principal laboratory technical directors, which will permit broader ranging assignments for incumbents. We hope this pattern will be adopted by the Army and Air Force.

• Finally, we have on many occasions encouraged our laboratories to contribute their specialized resources, on a selective basis recognizing DOD priorities, to solving the problems of other Federal agencies, such as law enforcement with the Department of Justice, housing with the Department of Housing and Urban Development, and air traffic control with the Federal Aviation Agency.

My overall assessment is that we have made some clear progress along well conceived lines, yet much remains to be done.

Federal Contract Research Centers

* * * *

This year I would like to present a few general points in our recent thinking about the Federal Contract Research Centers (FCRCs).

First, we are again emphasizing an extremely careful and comprehensive review of the programs assigned to each FCRC. My staff and I now regularly discuss the pertinent critical defense problems faced by the Defense Department with key executives of the FCRCs and with representatives of their military department sponsors. As a result of these discussion, I believe we can have even greater confidence that their programs have significant bearing and direct impact on solving our crucial problems. . . .

Second, we have reconsidered recently an issue which has been brought up from time to time for several years—whether or not these primarily DOD-sponsored organizations should be permitted or even encouraged to apply selectively their specialized capabilities to major domestic problems, such as transportation, urban redevelopment, housing and medical services. We have concluded that when an FCRC has capa-

ities suitable to a non-defense ent, it should be permitted to lertake non-defense work. In short, believe DOD has developed in FCRCs a "national resource" ich should be used as national orities dictate, consistent with our ds in the national security area. is I have begun discussions with er parts of the Federal Govern- it and with the FCRCs to intro- e this concept of "selective diversi- tion." I must add, however, that do *not* intend to fund programs igned to solve domestic problems, do we intend to act as a perma- t "middle man" in administering such programs. Similarly, we iot intend to reduce or dilute our) funding to FCRCs for national rity work, nor do we expect the Cs to reduce or delimit their ributions to defense needs.

inally, I want to outline our cur- thinking on the broadest of policy es related to the FCRC—the con- ing need for their sponsorship and ible changes in their funding and tions.

my testimony last year, I sum- zed our basic goals and needs for capabilities represented by the Cs. Those goals and needs are valid. We have received excellent ces from these organizations, and ill do. Their services are, in fact, ips more critical today than ever e simply because, as defense ems grow more complex, we need iany experienced and objective analysts, designers and managers as we can get. But certain changes have occurred during the past few years that will require continuing considera- tion of how we gain these services.

One important change, for example, is that civil service pay scales will reach approximate "comparability" with FCRC salary scales during FY 1970. This again raises the issue of whether we should study the possible advantages of transforming any of the current FCRCs into government institutes or laboratories. We under- stand that the possible advantages of government institutes are to be studied by the Bureau of the Budget on the recommendation of the General Accounting Office. We will of course cooperate in this study.

Another change is the increasing number of industrial and nonprofit groups which have capabilities simi- lar, but rarely equivalent, to those of the FCRCs. This raises the possi- bility of introducing somewhat more competition into the procurement of some of the services traditionally pro- vided only or largely by FCRCs. How- ever, the funding limitations on the FCRCs largely insure that their sponsors do not ask them to under- take tasks which can be accomplished elsewhere.

Another significant factor which I have already mentioned is the increas- ing interest by several FCRCs in taking work from non-DOD agencies, both because this work is challenging, and because such work provides an opportunity for professional and corporate growth not possible with the funding available during the past five years. Such "diversification" holds the promise, as I mentioned earlier, of helping the country solve some of its urgent domestic problems. But the process of diversification could lead the management of some FCRCs to consider moving out of the sponsored status and becoming an independent profit and nonprofit group. The choice, thus, is not entirely ours.

These changes sharpen old issues and raise a few new ones. Yet above all else they reenforce our awareness of the marked differences among the individual FCRCs, all of which were created to solve some specific problem which could not be solved as well at the time in any other way. Some are affiliated with universities and are highly specialized in a few research and development areas. Others are strongly hardware oriented and ex- clusively coupled to major develop- ment programs in the Military De- partments. A few are broad gauged and policy oriented, potentially capable of contributing to many national goals beyond DOD. Thus, it is difficult to make valid generalizations about them as a class.

Because of these changes, and be- cause of the diversity of the factors involved, we intend to stay very close to all of the management ques- tions regarding the FCRCs during the next year.

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ny Research Office

Combat Superiority Aim of Army Research Program

Colonel William J. Lynch, USA

lay's advanced society has bene- fited from many technological ces pioneered in the research levelopment programs of the Army. Among these advances mputers, dehydrated foods, and medical breakthroughs. Al- i Army research is not con- to directly benefit the civilian i of our population, the public eceived many spin-offs. Army h and development is conducted to insure that militarily necessary research will be done.

This article briefly describes Army research, as opposed to development, some of the results, and some aspects of research management.

To put things into perspective at the outset, a short look at the organi- zation which manages Army research is appropriate.

In the Army the Chief of Research and Development, Lieutenant General Austin W. Betts, accomplishes his mission through four directors:

- Director of Army Research (with which this article is concerned).
- Director of Plans and Programs, responsible for budgetary aspects and research and development plan- ning.
- Director of Developments, re- sponsible for hardware development from rifles to aircraft.
- Director of Missiles and Space, responsible for air defense weapons such as the Nike X and space projects, and nuclear, chemical and biological developments.

The Director of Army Research exercises general staff supervision of the research program of the Army; nearly half of the exploratory develop- ment; development and test of meteor- ological material and electron devices;

the Army medical research, development, test and evaluation (RDT&E) program; and the Army behavioral and social science program. Research in the atomic energy field is assigned to the Missiles and Space Directorate.

The Research Directorate also participates in the formulation of plans and programs in assigned areas of Army research and development. In its assigned areas of research and advanced technology, the directorate provides a general staff element responsive to the Assistant Secretary of the Army (Research and Development) and to the Chief of Research and Development, and in their relations of a scientific and technological nature with the Office of the Director, Defense Research and Engineering (ODDR&E), the Navy, Air Force, and the general scientific community. In addition, the Research Directorate provides a scientific analysis and evaluation capability for the Office of the Chief of Research and Development (OCRD) in those areas of research and advanced technology assigned to the Director of Army Research.

The Research Directorate is responsible for:

- General support and stimulation of science and technology for the Army.
- Monitoring Army science information activities.
- Preparation of the annual Army Long-Range Technological Forecast.
- Planning and programming for, nd supervising the execution of the rmy-wide portion of the research nd development program.

The director supervises and coordiates the operations of four Federal ontract Research Centers:

- Research Analysis Corp.
- Human Resources Research ffice.
- Center for Research and Social 'stems.
- Army Mathematics Research enter.

Assistance is given by the Research irectorate to the Development and he Missiles and Space Directorates of OCRD by providing analyses and ıssessments on the application of ıdvanced techniques and concepts to he solutions of problems. It also provides staff supervision and prepares policy and administrative procedures for execution of the program assigned to the Army by the Advanced Research Projects Agency of ODDR&E.

The Army Research Office

The Army Research Office (ARO) is the largest of seven field activities of the Research Directorate.[1]

Figure 1 shows the internal organization of ARO. A small office provides administrative and logistical support. Two offices, Plans and Programs, provide staff support. There are six scientific and technical divisions. Civilian scientists and technically trained military officers perform an unique function of scientific support for the whole Army staff. They provide a consulting capability in many disciplines of interest to the Army, as well as liaison and coordination with other Federal agencies, and industrial and academic institutions. Consultants have been furnished for such diverse projects as investigating safety aspects of the use of lasers, and the utilization of information processing, storage and retrieval.

As the executive agent of the Directorate of Research, ARO awards and administers research contracts and grants in selected areas. The following is breakdown of the overall Army FY 1969 RDT&E program by category and shows the portion monitored by ARO (dollar amounts are in millions):

	Total RDT&E	ARO Monitored
Research	$ 94.3	$ 94.3
Exploratory Development	238.4	112.4
Advanced Development	371.7	13.9
Engineering Development	151.6	5.5
Management and Support	266.3	17.9
Operational System Development	543.5	—
Total	$1,624.1	$237.6

[1] *The other field activities of the Army Research Directorate which execute portions of the RDT&E program are: the Behavioral Science Research Laboratory, Rosslyn, Va.; the Army Research Office, Durham, N.C.; the Army Research Office, Europe, Frankfort, Germany; the Army Research Office Latin America, a portion of the Defense Research Office, Rio de Janeiro, Brazil; the Army Research Office Far East, Tokyo, Japan; and the Operations Research Advisory Group, located at the Research Analysis Corp. in McLean, Va., which has no program execution responsibility.*

As indicated in the preceding table, ARO monitors all of the research category, and nearly half of the exploratory development category. The definition of exploratory development has been broadened in recent years, and can best be described as applied research rather than development. The remainder of the exploratory development category is monitored by the Developments Directorate and the Missiles and Space Directorate of OCRD.

ARO also monitors small portions of advanced development, engineering development, and management and support categories. In advanced development and engineering development, the effort is directed primarily toward therapeutic development and general combat support. The major effort in the management and support category is concentrated on studies and analyses directed toward developing analytical methodolgy for operational and research and development planning.

Colonel William J. Lynch, USA, is Assistant Director of Army Research, Office of the Chief of Research and Development, and Commander of the U.S. Army Research Office. His experience includes command of the 739th Nike Battalion, Boston; and staff assignments in the Advanced Research Projects Agency, and as Deputy Chief of Staff, U.S. Army Hawaii. He holds a B.S. in mechanical engineering from Tufts College and an M.S. from New York University Guggenheim School of Aeronautical Engineering.

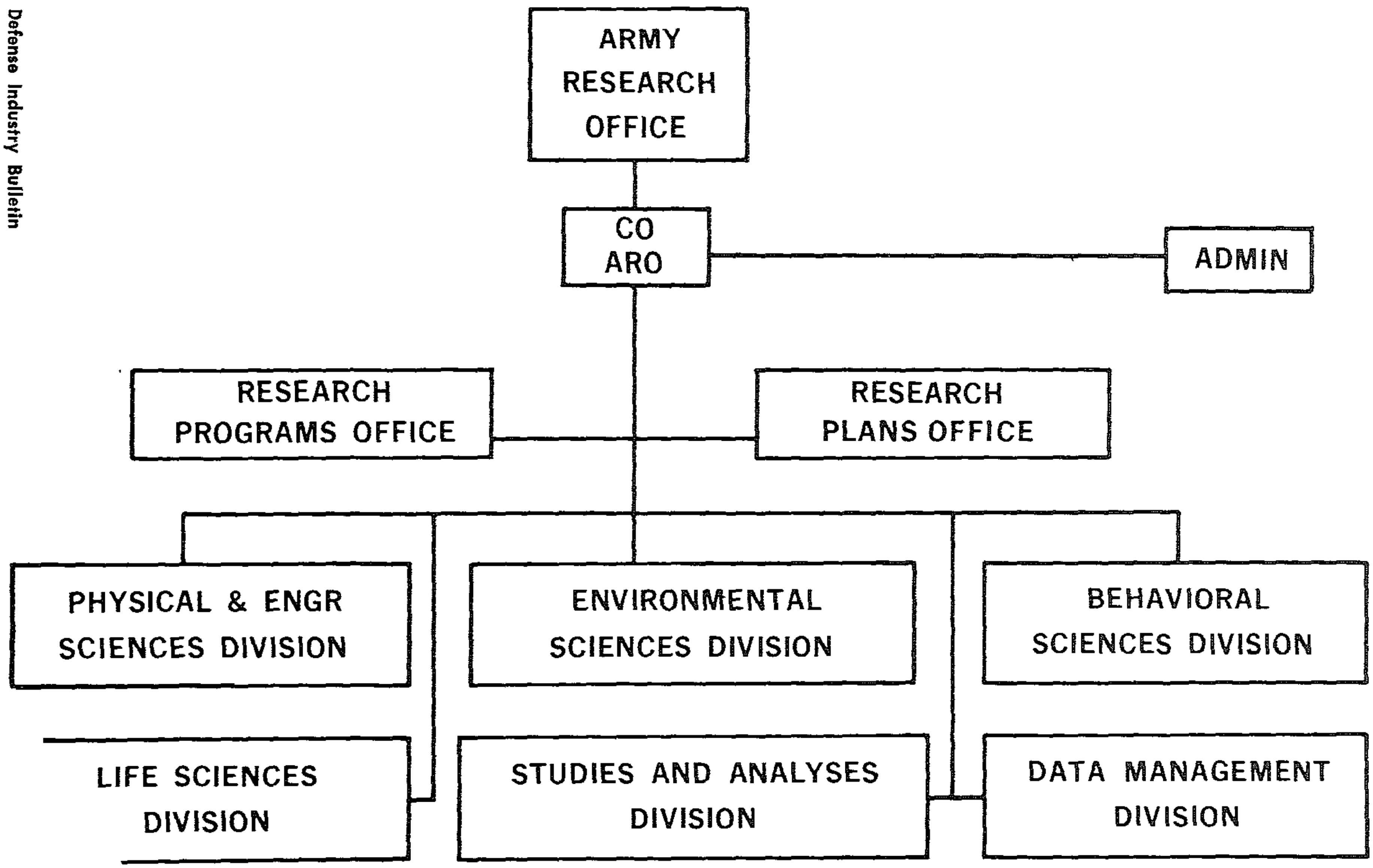

ARMY RESEARCH OFFICE
CO ARO
ADMIN
RESEARCH PROGRAMS OFFICE
RESEARCH PLANS OFFICE
PHYSICAL & ENGR SCIENCES DIVISION
ENVIRONMENTAL SCIENCES DIVISION
BEHAVIORAL SCIENCES DIVISION
LIFE SCIENCES DIVISION
STUDIES AND ANALYSES DIVISION
DATA MANAGEMENT DIVISION

FIGURE 1

Thus ARO has two distinct functions. First, as a general staff element of OCRD, it monitors the total research program and part of the exploratory development program preformed by the eight developing agencies of the Army. Second, as one of these eight developing agencies, ARO also executes part of the program it monitors. In addition, ARO serves as the contact point with the civilian scientific community. In addition to ARO, the other seven developing agencies in the Army are:

- Army Materiel Command
- Office of the Surgeon General
- Army Combat Developments Command
- Office of the Chief of Engineers
- Army Security Agency
- Advanced Ballistic Missile Defense Agency
- Safeguard Systems Office

ARO handles funds for a number of other organizations: the Limited War Laboratory at Aberdeen, Md.; the five Human Resources Research Units at Forts Benning (Ga.), Knox (Ky.), Bliss (Tex.), Rucker (Ala.), and the Presidio of Monterey (Calif.); and three Standardization Groups in Australia, Canada and the United Kingdom.

The $237 million plus monitored by ARO amounts to over 14 percent of the total Army RDT&E budget. Army research now includes over 3,000 tasks in the life, physical, environmental, social and other allied disciplines. The tasks are performed by 60 Army laboratories, approximately 225 universities and colleges, 161 non-profit institutions, and over 300 private firms. About 60 percent of this effort is done by the Army in-house; the remainder is performed by outside agencies.

The figures cited do not show the breadth of the Army's involvement with science and technology due to the diversity of its needs. This is particularly true as the Army faces the problems of the Cold War, where it finds itself engaged in a type of war calling for knowledge and concepts heretofore unknown. Unlike the sailor and the airman, the soldier finds himself immersed, as in Vietnam, in the total environment of the enemy—psychologically, socially, culturally, politically, and in armed conflict.

Basic Research

The ultimate objective of Army research is to assure that the development of new weapon systems, equipment and operational capabilities for the Army is qualitatively superior to that of any potential enemy, in any environment, and under all conflict conditions. In essence, Army research is ultimately "requirements" oriented. However, one must remember that the end product of *basic* research, new knowledge or science, remains dormant until *applied* research and development either converts it into a piece of new equipment in the hands of the troops, or satisfies a non-material requirement. Examples of the latter might include a more efficient training procedure, a more effective immunization technique, or possibly improved methods for countering low-level conflict in developing countries.

Basic research tries to look into the future for as much as 20 years. The Army is particularly aware of the need for this basic research and continues to support it to the limit of available funding. It is the key to future developments—to the realization of new concepts and designs just over the horizon. In the research area, the Army is "scientifically" oriented, as opposed to "requirements" oriented. The purpose is to increase knowledge of natural phenomena, of the environment, and of problem solving in the physical, behavioral and social sciences, having in mind only broad, long-term military needs. Research in science is fundamental to the Army follow-on development effort because most technological advances are rooted in this basic research. From this point on, research in science becomes more directly oriented toward the Army's operational requirements.

As might be expected, basic research is organized along lines of fundamental science.

The most significant recent impacts upon the level and direction of the Army research program have come from declining funding trends and the war in Vietnam.

Funding for Army research, adjusted by a 5 percent a year cost of living increase, is about 30 percent lower in FY 1969 than the peak year of FY 1965. Distribution of funds for basic research in FY 1969 is (in millions):

Behavioral and Social Sciences	$ 1.4
Life Sciences	22.1
Environmental Sciences	6.1
Engineering Sciences	25.9
Physical Sciences	15.5
University Program and Joint Services Electronic Program	10.6
In-house Laboratory Independent Research Program	11.6

Funds for the In-house Laboratory Independent Research Program are used for research at the various laboratory directors' discretion. The intent is to give individual Army research personnel the means to increase their competence while promoting a vigorous internal research program.

A recent addition to the Army research activity is an experimental university program named Project THEMIS, started as a result of the President's request in 1965 that all agencies contribute to building new academic centers of excellence. This project has the goal of increasing the number of education institutions capable of performing quality research and, thereby, increasing the diversity of scientific inquiry. Under this approach, inter-disciplinary, university-administered programs are established to perform research in specialized areas relevant to defense missions. To date, 92 programs at 66 universities in 40 states have been selected for participation, with the Army monitoring 29 programs.

Exploratory Development

The second major category of the Army research and development program is exploratory development. The key distinction here is the increasing orientation toward specific military problems. As in basic research, control is exercised largely by "level of effort" funding in the various fields working toward solving individual problems.

The exploratory development program is organized into 31 program elements, 22 of which have all or part of the projects monitored by the Army Research Office. The effort is organized into functional or broad technological areas such as avionics, ground surveillance, target acquisition, or missile propulsion.

The decrease in actual level of effort in exploratory development was even greater than for research. Dr. John S. Foster Jr., Director, Defense Research and Engineering, in Congressional testimony indicated that the adjusted level for exploratory development in FY 1968 was equivalent to slightly more than half the

level in FY 1964. He specifically cited avionics, data processing, electron devices, communications and radar as areas with significant under-funding, and he argued that substantially greater funding was needed.

During this same period of reduced effort, the impact of the Vietnamese war insured that certain more immediately relevant requirements received greater emphasis. The normal payoff period for research and exploratory development work has been estimated as 5 to 20 years. Where possible, the research and development community has attempted to shorten the normal cycles by accelerating programs directed toward the requirements for jungle and guerilla warfare in Southeast Asia.

A partial list of such priority military areas would include:

- High strength, lightweight materials.
- Lightweight, transparent armor.
- Dust palliative to minimize helicopter damage.
- Surveillance, including personnel and tunnel.
- Lightweight, durable batteries.
- Silent power sources (fuel cells).

In general, these problem areas arise from increased emphasis on air and ground mobility, and the need to operate against an elusive enemy under difficult conditions.

Payoff of Army Research Program

Touching briefly on some accomplishments of the Army research program, as opposed to development, there have been many somewhat intangible results in mathematics from the Army Mathematics Center, various laboratories and contractors, and in such things as basic chemistry, metallurgy, crystallography, etc., where the application is not direct or apparent.

Concrete examples can be given, however, and some of the most important, with very early payoff, have occurred in the areas monitored by the Behavioral Sciences Division.

Significant accomplishments of the Human Resources Research Office (HumRRO) include:

- A short automated Vietnamese language course for military advisors.
- Improved models of training programs for electronic technicians.
- Improved combat training for the infantryman and for leaders of small infantry units.
- Aircraft recognition training.
- Leadership training programs for non-commissioned officers and for those at senior levels of command.
- Methods and techniques for improving the output of ROTC graduates, including establishment of requirements for the ROTC military science curriculum.
- Background information on the learning capabilities of personnel in lower mental categories.

Many of these have resulted in appreciably shortened training time and school courses.

The Center for Research in Social Systems (CRESS) pursues a program of research developed along four major lines of inquiry:

- **Cross-cultural influence and interaction, including military psychological operations and analyses of foreign cultures.** Of importance has been a series of 26 country studies, known as Intercultural Communications Guides. A basic research task has developed the Associative Group Analysis Technique as a means of improving cross-cultural communications. Other studies have developed a systems analysis approach to the subject of psychological operations, and have analyzed U.S. Army requirement for psychological operations on a world-wide basis.
- **Dynamics of behavior in revolutionary situations.** Studies have been produced dealing with the communist insurgent infrastructure in Vietnam, problems in internal security in insurgent situations, and a systematic and comprehensive analysis of over 50 specific historical internal conflict situations in the 20th century.
- **Military assistance programming and civic action.** Investigations have been made on the role of the military establishment in developing nations, the effects of specific civic action programs, and the military advisory effort conducted by the U.S. Army in Vietnam and other areas.
- **Information management.** This area is represented by an information center devoted to the social sciences, the Cultural Information Analysis Center (CINFAC). This center was established in July 1964 to provide an extensive informational base and analytical expertise on the problems of internal defense, socioeconomic development, and rapid social and cultural change. CINFAC services a wide variety of government agencies and industries, and complements and supplements the research efforts of the parent organization, CRESS. CINFAC alone has provided over 1,000 responses to qualified users in its four-year existence.

Other important contributions have been made in these areas by the Human Engineering Laboratories at Aberdeen, Md.; Natick Laboratories, Natick, Mass.; and several contractors.

The U.S. Army Behavioral Science Research Laboratory has developed computerized mathematical personnel assignment models, command and control systems, night vision devices, and improved combat proficiency predictions. Recent accomplishments in the basic research area have been development of an aptitude test useful in identifying motivational failures and in measuring mental ability, and the development of computerized manpower flow models.

Of the endeavors monitored by the Environmental, the Physical, and the Engineering Sciences Divisions, perhaps the most immediately important were remote sensing of the ground environment, the people sniffer, night vision devices, and improved aircraft and body armor, including some important work being done right now on transparent armor. Work with satellite photographs resulted in better ground mapping, and has enabled cartographers to correct erroneous maps. Also well on the way is a technique, called multi-spectral analysis, which will permit determination of militarily significant aspects of soil type and condition for trafficability purposes, and ground formations and other information from simultaneous photographs.

A great deal of work is being done with various types of lasers and many potential applications are undergoing development. One of these involves the use of a hologram for storage of three-dimensional information. A hologram is a two-dimensional photographic record containing the necessary information to provide a three-dimensional reproduction of an object. It is made by combining on a photographic plate (or other light-sensitive medium) scattered light from the object with a reference beam of light; the light from a lase[illegible] used in order that the r[illegible] beam may form a proper [illegible] pattern with the scatt[illegible] the exposed film [illegible] laser, a true thre[illegible]

is produced, which may be photographed in the ordinary manner from aspects just as though the actual object were available.

Using these techniques, a large number of holograms may be stored in a single, small, light-sensitive crystal. Storage of thousands of different scenes in one crystal is possible. Potential applications of holography under investigation include use in read-only memory for computers, eliminating the necessity for highly accurate registration of information bearing cards, and in surveillance work where multiple holograms on a single film may provide more and better information.

In another area of research, wind tunnel testing of scaled models is an established practice for simulating the real aerodynamic flow field of conventional fixed-wing aircraft. In the case of V/STOL aircraft, errors in simulation caused by the interaction of airstreams with tunnel walls had been recognized and supposedly corrected to allow accurate predictions of performance of an actual V/STOL aircraft in flight. Army-funded research on the interaction of downwash on wind tunnel walls showed gross inaccuracies in the simulation of rotary wing flight. For a given size V/STOL test vehicle, the optimum shape and size of a tunnel, the maximum and minimum wind speeds which will yield meaningful results, the permissible downwash angles, and the positioning of the test vehicle in the tunnel were determined. Conversely, for a given wind tunnel, the maximum size model that can be tested meaningfuly was determined.

The immediate effects of this research are re-evaluation of previous V/STOL model test and design data, redesign of proposed new wind tunnels, and establishment of proper model sizes for existing wind tunnel installations. This is not really a typical example, because it is rare that basic research yields such recognizable and timely benefits. It has been estimated that "incurred and anticipated expenditures on aircraft and associated wind tunnel facilities influenced by this research will easily amount to several hundred million dollars."

Research Results in Biomedical Field

The translation of research results into applications is particularly rapid in the biomedical field. Hepatitis has been a threat to military operations throughout history. Non-effectiveness of those afflicted is considerable, due to the prolonged hospitalization and convalescent period usually required. The goal of the hepatitis research program is production of an effective vaccine which would eliminate the threat of this disease. To do this, the viral agent must first be isolated and characterized. It has recently been shown that marmoset monkeys develop biochemical and pathological evidence of hepatitis when given serum from human cases. This discovery of a suitable laboratory animal represents a major breakthrough in the field of hepatitis research. The availability of laboratory animals may hasten development of an effective vaccine, and at far less cost than expensive field experiment.

Similarly, malaria has decimated more armies throughout history than any combination of man-made weapons, and it has become a major problem to the U.S. Army. Particularly virulent strains of malaria have been encountered in Vietnam and, as many readers probably are aware from reading magazine and newspaper reports, the falciparum strain also turned out to be drug resistant. A program, which has screened over 125,000 drugs, identified about 15 as showing great promise in humans, and several times this number which look good but are not ready for human testing. Cost of the program, plus some research into the mechanisms of the disease, is running approximately $10 million annually.

A spray adhesive was developed by the Medical Research and Development Command for emergency use to stop otherwise uncontrollable bleeding. The technique is still in the experimental stage, and is used only when other hemorrhage control measures fail. It is credited with saving the lives of seriously wounded men in Vietnam, particularly those with liver and kidney wounds, when usual surgical techniques are ineffective. One of the materials used is isobutyl cyanoacrylate.

A new drug, sulfamylon, extensively tested by the U.S. Surgical Research Unit at Brooke Army Medical Center, Fort Sam Houston, Tex., has resulted in dramatic improvement in treatment of seriously burned patients.

And lastly, a new approach to vascular surgery greatly reduces the number of amputees in combat wounds, as well as in cases of limb injuries from automobile accidents.

Many more examples of direct applications could be cited which incorporate or depend upon advances in science, in techniques, or in materials. A great deal of effort produces less tangible results, often with no foreseeable immediate application, but representing small, finite additions to the nation's store of knowledge.

Relevance of Research

This leads to consideration of the subject of relevance of research results to assigned missions, functions, or responsibilities, a subject which is receiving increasing attention because of budgetary constraints and the need to achieve the greatest return from the shrinking research dollar. The Army Research Council, addressing this subject and the fundamental reason for Army involvement in science and research, stated:

> **A major reason for Army involvement in science and research is to assure that all technological areas important to the Army are exploited. Some of these areas which are of particular concern to the Army, or in which it has a dominant role, are Explosives, Ground Mobility, Tropical Medicine and Chemical and Biological warfare. The Army must be the leader and actually perform the bulk of the research in these areas or the work would not be done.**
>
> **There are many other areas of research covered by other organizations within the Federal Government, in industry and in the academic world, in which the Army must also engage. A few examples are electronics, materials, medicine and meteorology. It is necessary for the Army to do research in these areas in order to fill gaps and study fundamental problems having direct bearing on its mission. Such considerations as mobility, ruggedness, and reliability have special importance to the Army and clearly justify Army participation.**

The Army Research Plan (ARP), prepared by OCRD, provides guidance to the research and exploratory development programs to ensure that they are responsive to the long-range concepts and materiel objectives of the future.

Recently, in the preparation of the ARP, the current research program was thoroughly reviewed to ensure that the scientific and technical areas of most interest to the Army are emphasized, and that favorable balance among areas is attained. Factors considered include:

- Current state of the art in the area.
- Probability of significant returns from the work.
- Relevance of the research to the Army's mission.
- Maintenance of in-house know-how, particularly in those areas where industry has little interest.

To clarify this point, two general goals can be defined for the Army research and exploratory development efforts. First, the larger portion of the effort is directed specifically toward generating technology needed for operational objectives. Second, some of the effort is expended to seek and capitalize on unexpected developments in science or technology. Both types of research can benefit from the development of valid, long-range research objectives which can provide direction to, but not unnecessarily restrict, the research effort.

A meaningful list of research objectives is critical to all stated aims of the ARP. An approved list of Operational Capability Objectives has only recently become available. Prior to this, as an interim measure, a list of objectives was derived from the OCRD research planning guidance statements and the Joint Research and Development Objectives Document.

In order to obtain an overview of the manner in which the research program supports these objectives, exploratory development projects were appraised against 179 detailed objectives. Judgments were made on the degree of relevance of the project to the objective and as to the adequacy of the current level of support. The research projects were linked indirectly to the objectives by appraising them against the exploratory development projects in a similar manner. The result is a qualitative profile of the research program which, hopefully, can become a useful management tool. A similar exercise will be conducted using the approved Operational Capability Objectives for the next edition of the ARP, expected in the fall of 1969.

As has been pointed out in the recent Army Research Council report: Past Army research has contributed materially in the context of "payoffs" in the modern Army. Innovations are clearly evident in the manner in which the Army moves, uses firepower, communicates and sustains itself. These achievements are not insular to the Army, but have had incidental impact, so far as the Army is concerned, on the economies of the nation and the world. A few examples of these are:

- The computer industry was further stimulated by Army research at Aberdeen Proving Ground to provide a computing capability for firing tables.
- Recent research in low-speed aerodynamics has led to major improvements in helicopters and hovering aircraft.
- Army research and research support of microminiaturized electronic circuits provided a substantial basis for that industry. In a related field, the first satellite communication systems were built through Army research.
- The Army's need for prepackaged food for field rations led to several food preparation industries, such as irradiated and dehydrated foods.
- Army medical research established large areas of activity, such as public sanitation, tropical disease control, blood-handling procedures and burn treatment.

The Army will continue to possess an imaginative and productive research organization capable of exerting an aggressive role of leadership in all scientific fields responsive to its needs.

Office of Naval Research

Research Today for Tomorrow's Navy

Rear Admiral Thomas B. Owen, USN

Man today can routinely dive more than a mile down to the ocean bottom in a research submersible to peer and grope at its alien environment; gather scientific data telemetered daily from an unmanned buoy moored hundreds of miles out at sea instead of waiting for a research ship to return to port months later; live and work on the ocean floor for weeks in a scientific laboratory; and receive a blood transfusion of whole blood obtained many months before and preserved by freezing. This and much more can be accomplished now as a result of Naval research carried out yesterday.

Within the Navy, all research and development is under the direction of the Assistant Secretary of the Navy (Research and Development). "Research and development," although commonly used as a single expression, actually connotes a wide range of endeavor. Indeed, the appropriation which provides the Navy with funds for its research and development program is entitled "Research, Development, Test and Evaluation, Navy."

Procurements which carry the label, research and development, range in size from small basic research contracts, wherein the Navy supports fundamental studies, to large contracts for the fabrication of the first prototype of an operational system. As an equipment procurement moves down the path to operational systems development, the requirements become more definitive, the planning more extensive, and the work more costly to perform.

The responsibility for the part of the Navy research and development program, designated as Defense Sciences (Research), rests with the Chief of Naval Research who heads the Office of Naval Research (ONR) and reports directly to the A[illegible] Secretary of the Nav[illegible] Development). The the Office of Na[illegible] back to 1946, whe[illegible]

U. S. agency with the major mission of supporting research at American universities and laboratories by contract.

Its establishment represented a unique and even revolutionary move at the time. Prior to this, the Federal Government had little experience in negotiating and administering long-range basic research contracts with universities or private research organizations. The standard government contract up to then was primarily designed to cover the purchase of tangible goods or specific services, generally from industry.

As the first permanent Federal agency to support basic research, the Office of Naval Research, in many respects, has served as the patternmaker in the government support of research for Army, the Air Force, the National Science Foundation, the National Institutes of Health, and the National Aeronautics and Space Administration.

The basic mission of the Office of Naval Research, with headquarters located in the Main Navy Building, Washington, D. C. 20360, is to plan, promote, initiate, conduct and coordinate Naval research. While concerned primarily with basic research, ONR also sponsors applied or directed research, as well as some exploratory developments leading to experimental prototypes. Basic research is considered the predominant area of research, and is aimed at gaining broad fundamental knowledge of a scientific field with a pure science approach.

Rear Admiral Thomas B. Owen, USN, has been Chief of Naval Research and head of the Office of Naval Research since July 1967. Before this assignment, he served as Director of the Naval Research Laboratory, and has held numerous positions in the Navy in the research and development field. Admiral Owen holds a B. S. degree in chemical engineering from the University of Washington, and a Ph.D. in chemistry from Cornell University.

In practice there is a carefully planned program to build up knowledge in every scientific discipline that can potentially be related to Naval operations. Frequently, specific Navy benefits to be gained from the research are unpredictable at the start of the study. In many cases, Naval research attempts to have a solution to a problem ready before the problem arises.

ONR's program of supporting research through contract awards is based largely on unsolicited proposals. These are both formal and informal and come from all types of research groups, including universities, private institutes, and industrial laboratories.

In cases where the research objective requires experimental hardware, ONR solicits proposals in order to select responsible contractors who are technically qualified to perform the necessary specialized work. Since the preparation of technical proposals can be costly, an attempt is made to limit requests for proposals to those sources which are qualified to perform the planned tasks. In order to stimulate and increase competition, however, a concerted effort is made to expand the number of qualified sources. One aspect of doing this is to encourage small business concerns to submit their qualifications. Within ONR, proposed procurements for industry are reviewed by small business specialists to determine that proper consideration is given to participation by small business.

ONR's objective is to prepare a contract which clearly and completely outlines the task to be done and, at the same time, permits flexibility and encourages creativity. Also, ONR has attempted to make contract reporting compatible with its needs without making excessive demands on the contactor.

The entire Navy Patent Program is operated by ONR, providing professional services and advice to Navy personnel and contractors with respect to patents, inventions, trademarks, copyrights and royalty payments.

Branch Offices

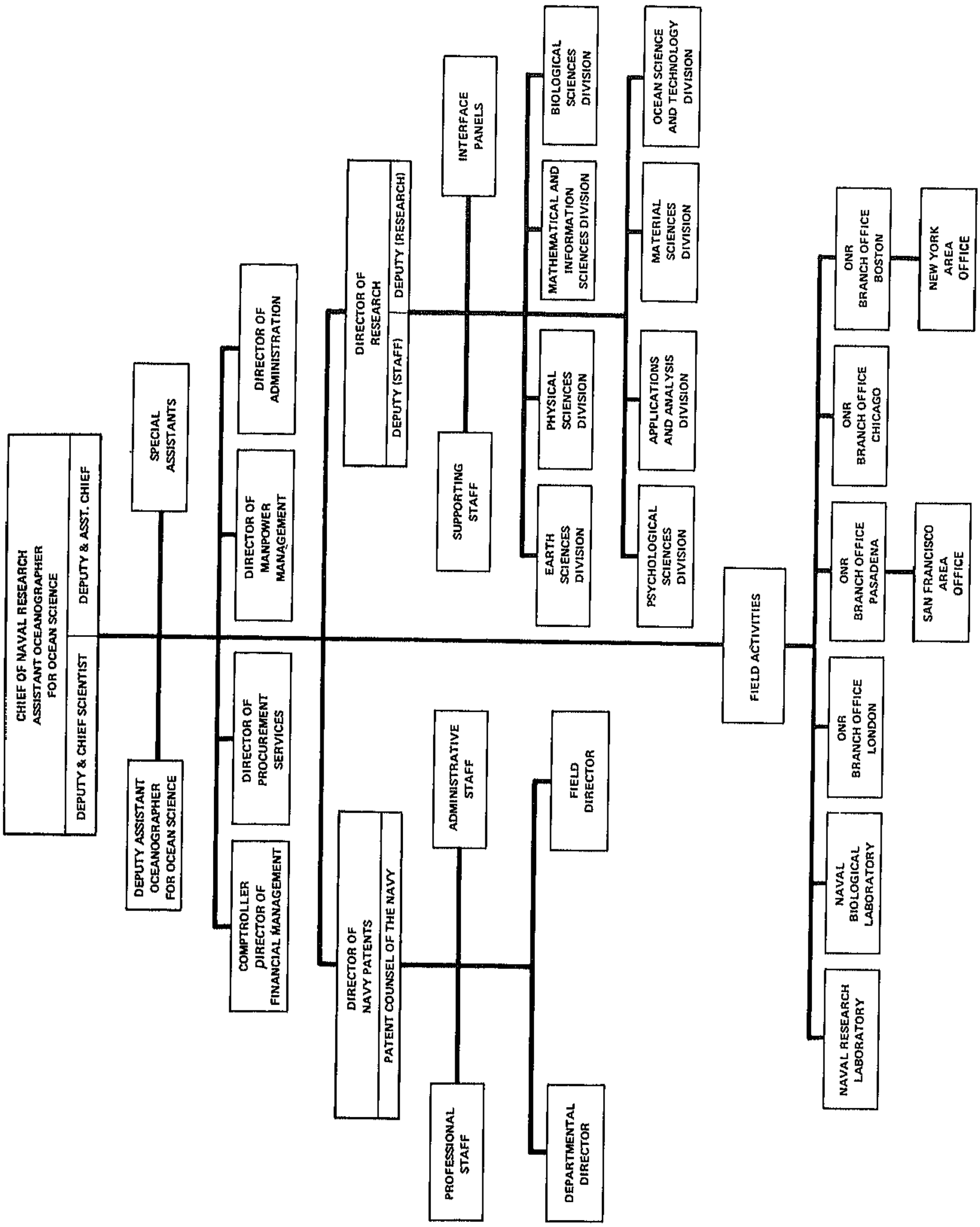
To maintain close relations with the contractor or potential contractor, ONR operates branch offices in Boston, Chicago and Pasadena. The Boston branch office maintains an area office in New York, and the Pasadena office operates an area office in San Francisco.

Branch offices facilitate direct liaison between ONR and scientific institutions, research investigators and contractors. They report on research findings, trends, potentialities and achievements. Furthermore, they monitor ONR tasks and research projects to identify and report on scientific and technological advances that have potential importance to the Navy. In addition, the contract administration department of each office performs comprehensive contract and property administration services on research contracts and grants placed with various institutions.

These services, involving contracts with educational institutions, are provided not only for the Navy but also for the Army, the Air Force and the National Aeronautics and Space Administration.

Within the branch office areas, there are 24 resident representatives, located at major universities, to provide contract administration services on a more localized basis. The branch offices also have an Office of Patent Counsel to assist contractors in patent and copyright matters.

In addition to its continental branch offices, ONR operates a branch office in London, England. This office represents the Assistant Secretary of the Navy (Research and Development), the Chief of Naval Operations, the Chief of Naval Material, as well as the Chief of Naval Research, in all matters of general scientific and technical interest to the Navy in the United Kingdom and Europe. The London office surveys scientific trends, potentialities, and achievements in research and development by maintaining liaison with all agencies in those areas conducting programs of interest to the Navy. The work is performed by a staff of U.S. scientists and Naval officers who regularly visit academic, industrial


CHIEF OF NAVAL RESEARCH
ASSISTANT OCEANOGRAPHER FOR OCEAN SCIENCE
DEPUTY & CHIEF SCIENTIST
DEPUTY & ASST. CHIEF
SPECIAL ASSISTANTS
DEPUTY ASSISTANT OCEANOGRAPHER FOR OCEAN SCIENCE
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SAN FRANCISCO AREA OFFICE
ONR BRANCH OFFICE LONDON
NAVAL BIOLOGICAL LABORATORY
NAVAL RESEARCH LABORATORY

and governmental research and development organizations in the United Kingdom, Western and Eastern Europe, and the Middle East.

ONR Laboratories

The Office of Naval Research operates one in-house laboratory, the Naval Research Laboratory (NRL) located near Washington, D. C., and two other laboratories under contract.

NRL was established in 1923 to ensure that advancements in science and engineering could be applied readily to Navy needs. When ONR was established by Congress in 1946, the laboratory came under its control and formed an important element of the organization.

The mission of NRL is to conduct scientific research and development in the physical sciences and related fields directed toward new and improved materials, equipment, techniques and systems for the Navy. The laboratory occupies 126 acres of land and employs 3,600 civilians, of whom some 1,900 are members of the Research Department. NRL field activities, scattered from New York to Florida, provide unique environments and facilities not available at the Washington, D. C., site.

One of the two laboratories operated by ONR through contract is the Naval Biological Laboratory in Oakland, Calif. This laboratory is operated under the command of a Naval officer who reports to the Chief of Naval Research. Its research is conducted through contract with the University of California School of Health. Recognized by the scientific community for its excellence in aerobiology research, the laboratory also emphasizes medical and environmental microbiology.

The other laboratory is the Naval Arctic Research Laboratory (NARL), operated by the University of Alaska through a contract with the Office of Naval Research. Well equipped laboratories at NARL support all forms of basic and applied research related to the Arctic, particularly in the fields of oceanography, marine biology, geophysics, and underwater acoustics. NARL also maintains an extensive network of semi-permanent, permanent and temporary research camps on land and drifting stations within the ice pack of the Arctic basin. The area of operation on land includes all of Alaska northward and westward from the Brooks Range to the coast. At sea, drifting stations are established and maintained largely within the Chukchi and Beaufort Seas although one ice station has drifted as far as the Greenland Sea.

Challenges and Achievements

During its 21-year span of research ONR has met formidable challenges offered by science, and achieved new scientific knowledge to maintain the Navy's control of the ocean on behalf of national security.

A good example of long-range basic research and how it can eventually result in broad applications is the story of the maser and the laser. ONR has played a key role in outlining, planning and supporting research in this field, just as it has in solid state physics and other areas of physical sciences. Work in the general field of microwaves spectroscopy supported by ONR, the Army and the Air Force led to the discovery of the maser.

The Navy made good use of the maser in low-noise receivers for radio telescopes and developed an ultra-precise atomic clock for a navigation system. Later ONR-sponsored research in this field contributed to the discovery of the laser. Given responsibility in that field by DOD, ONR has made major contributions to laser research and technology. New materials and improved pump sources for the laser have been studied and developed to achieve maximum brightness and high power. One ONR-supported research project is studying the idea of employing a laser beam in conjunction with conventional radar to obtain a sharper resolution.

One of the early fields of science that felt the impact of ONR effort was nuclear physics. The programs enabled the United States to move vigorously ahead in this field, and ensured that no time was lost in the interim before the Atomic Energy Commission (AEC) was established. Most of the 15 nuclear accelerators, which were built at universities in the decades following World War II, were started under ONR sponsorship. Funds were provided for the construction and operation of a linear electron accelerator at Stanford University, which led to the building of the new two-mile linear accelerator for AEC at Stanford. During the development of the linear electron accelerator, Stanford University scientists were faced with the problem of generating very high power required to accelerate the electrons to the proper speed. This problem was solved with the development of the klystron tube. The klystron, in turn, aided materially in the early development of high-powered radar.

Now, Stanford scientists are attempting to improve the accelerator program by making use of the phenomenon of superconductivity—the fact that electronic efficiency improves under supercold conditions. ONR is currently supporting the development of the cryogenic linear accelerator at Stanford not just for interest in nuclear physics, but because there is a belief that this basic research program should lead to advances in demonstrated application of cryogenic technology to Navy equipment problems.

ONR envisions that the use of cryogenic technology may result in such applications as gyroscopes virtually free from error, powerful magnets energized by a few storage batteries, and shipboard electronic equipment much more compact and reliable. Just as an understanding of the principles involved in this field was obtained from basic research, so it is now that basic engineering problems must be solved before it can become a full-blown technology. Toward this end Stanford scientists will employ the first large-size refrigeration system ever used to maintain an operating electronics system at a temperature 450 degrees below zero F.

Spin-off Aids Civilian Needs

Most types of Naval research have broad applications. In the case of biological research, work aimed clearly at Naval personnel has a much broader application. The Navy sponsored research aimed at developing techniques both for storing whole blood for long periods of time by freezing, and then being able to thaw it quickly and safely for immediate transfusions. Frozen blood has been used sucessfully by all the Military Services in Vietnam, and can be used for civilian purposes as well.

In fact, the use of frozen blood proved invaluable to the civilian community in the Boston area in

December 1968 during a flu epidemic when conventional supplies of blood were critically low. One civilian hospital in that area is now using frozen blood in surgery cases requiring large amounts of blood as in open heart surgery.

Another area of interest is the preservation of human tissues of different types. A number of casualties in Vietnam, suffering serious head injuries, were saved because of the availability of preserved dura, the brain lining lying just below the skull. Once again, an area of Navy interest can be of great value to the civilian population as well.

Included in biological research is the study of dental caries among Navy recruits. Investigations have proven that recruits reporting from certain parts of Ohio, South Carolina and Florida have no cavities at all. In addition to fluoridated water, which is known to help prevent caries, scientists have theorized there are certain chemicals in foods grown in those areas that inhibit the growth of cavities. Today, ONR continues to sponsor research to identify these chemicals. The solution will affect both the Navy and society as a whole.

Effective Relationship of Man and the Machine

The Navy has long recognized the value of research in the psychological sciences, particularly in drawing men and machine together in a more effective relationship. ONR is presently engaged in a program of better integrating the aircraft and its crew. The objective is to improve both the many displays and the operations that must be performed, in some cases on an emergency basis. ONR pioneered efforts to provide adequate protection to minimize hearing damage to men working close to jet engines.

In another area of psychological science, a current research program is underway in the field of human engineering. It is aimed at the development of a servo-powered, "exoskeleton" structure to be worn by man to augment his strength and lifting powers up to 1,500 pounds. It would be used by the Navy and others in areas where heavy lifting equipment cannot be installed readily.

The Navy envisions the computer as the key to significant improvements in human performance. In this area work is being directed toward development of more effective communication between man and computer. The tireless computer can improve the quality and can speed the teaching of recruits. This improved teaching method is necessary to train effectively the large number of young men required to operate and maintain highly sophisticated Naval systems. The Naval Academy, in a pilot program, has already installed an educational computer that is programmed for a variety of language, social science, engineering, and mathematical courses for midshipmen.

Oceanographic Research

Among the first programs started at ONR was oceanographic research. New ocean-probing tools have been developed, including ships especially designed for oceanographic research. Common examples of tools being used today as a result of such research are gravity meters, magnetometers, underwater TV cameras with strobe lights, and many others. Much of the equipment presently in use aboard these ships resulted from ONR-sponsored research.

More recently, ONR has developed the first long-range, unmanned, telemetering oceanographic buoy, capable of recording a variety of data from down to a depth of 20,000 feet and telemetering it up to 2,500 miles back to shore-based stations.

During the past decade, oceanographers had searched for such an instrument or vehicle that would handle deep sea data over a long period of time. The ONR-sponsored project for the development of such a buoy was the answer. The buoy is appropriately labeled the "Monster Buoy" because of its huge size, being 40 feet in diameter. Information recorded by the buoy's sensors may be telemetered daily by up to 100 channels to shore-based data stations, or can be stored in another memory system at sea unattended, for as long as one year. The development of the Monster Buoy has, thus, provided oceanographers a convenient system for obtaining a variety of information much more rapidly and efficiently than was before possible.

The development of a deep-diving research submersible, through ONR-sponsored research, has opened up a new world of scientific promise by its capability to dive more than a mile down to the ocean's bottom to obtain scientific data.

ONR initiated the operation of deep-diving vehicles in this country with the purchase of the bathyscaphe Trieste in 1958. This vehicle made the first major conquest of the ocean depths when the Navy took it down into the deepest ocean trench known to exist, the Mariannas Trench, descending to an official depth of 35,800 feet, a record that still stands. Recognizing that deep-sea research required a submersible that could maneuver, ONR turned to American industry which provided Alvin, the first deep-diving research submersible to go into operation.

Two new and improved versions of Alvin, the Sea Cliff and Turtle, are nearing completion. The Turtle, owned by the Naval Ships Systems Command, will work with ONR's Sea Cliff to be operated by the Woods Hole Oceanographic Institution, in a joint program beginning this summer.

These twin submersibles, which have a depth capability of 6,500 feet compared to the Alvin's 6,000 feet, are equipped with a vast array of scientific gear, plus television and other cameras equipped with strobe lights to obtain vivid photographs underneath the ocean. The submersibles are also equipped with a pair of remotely controlled mechanical arms that can obtain data from the water and ocean floor for further scientific study.

The broad application of Naval research is exemplified by the Navy's man-in-the-sea program. The pioneering Sealab I and Sealab II experiments, conducted by ONR in 1964 and 1965, established that man can live and work safely on the ocean bottom for long periods while conducting salvage and rescue operations, scientific studies, undersea mining, or underwater oil drilling.

TEKTITE I is a new project in this area, under the technical direction of ONR and supported by NASA and the Department of Interior, with the undersea habitat designed, built and furnished by the General Electric Co. The operation involved a team of aquanaut-scientists who lived in the habitat on the ocean floor at a depth of 50 feet for 60 consecutive days and conducted marine science studies in the area outside their habitat. At the same time their behavior was observed by psychologists and biochemical special-

ists using computer techniques for collecting and analyzing the data. The objective of the investigation was to gain more knowledge of marine science and the behavior of a small group of men confined in close quarters in a somewhat hazardous world. This data can be applied to both future undersea missions and to extended manned space missions.

For the past two decades research sponsored by ONR has not only greatly improved Naval capabilities, but has also had a direct effect on achieving major scientific advancements for our society. Such basic and applied research is vital to the continued effectiveness of the Navy, as well as the progress of the nation. Research conducted today will lead to the discovery tomorrow of new concepts and principles from which new technologies will evolve and major developments for our society will spring.

The operational capabilities of the Fleet today is the result of scientific research performed years ago. This "time lag" tends to mask the very real and direct benefits the Navy gains from basic research. The final impact of Naval research can never be measured fully or identified because it may be decades before the potential of a new principle, such as the laser, is fully exploited. Naval research, therefore, plays a key role not just in the future of the Navy but in the future of man.

Office of Aerospace Research

Management of Air Force Research

Brigadier General Leo A. Kiley, USAF

Albert Einstein once said that the most incomprehensible thing about the world is that it is comprehensible.

All research scientists work on this principle as they seek knowledge and understanding not only of *how* something behaves but *why* it behaves a certain way.

Research is a search for knowledge and understanding of the physical world, while technology is an attempt to get some measure of control over physical processes.

It required only six years from the control of nuclear fission in a laboratory experiment to the explosion of the first atomic bomb. In the process, the art of warfare was revolutionized.

While science and technology played an important part in World War I, it was a secondary role as compared to World War II. During World War II the allies, for the first time in history, enlisted the aid of organized science for the decisive contribution of effective weapons. Never before had such large numbers of scientific workers been united for planned evaluation and utilization of scientific ideas for military purposes. This effort has continued to the present, and today, more than ever before, research is an important mission of all of the Military Services of the United States, as well as other countries.

The U.S. Air Force research program is the responsibility of the Office of Aerospace Research (OAR), located at 1400 Wilson Blvd., Arlington, Va. 22209. It is a challenging management responsibility and plays a vital role in the future of the Air Force and the security of the United States.

As a separate operating agency, OAR reports directly to the Air Force Chief of Staff on the same level as the major operational commands. Organizationally OAR is composed of five scientific organizations, two scientific support units, and three field detachments. With the exception of the Air Force Office of Scientific Research (AFOSR), all of our scientific organizations are in-house laboratories. AFOSR, the broadest in scope of our subordinate units, is our major interface with the overall world-wide scientific community and conducts its research through grants and contracts.

The two scientific support units represent our foreign research programs and have offices in Europe and South America. The field detachments, operating as part of OAR headquarters, are responsible for satellite, rocket, and balloon programs which provide our scientists with the means for getting their experiments into the upper atmosphere.

Compared to other Air Force commands, OAR is a small organization. Its 2,080 people represent about 0.2 percent of the Air Force personnel. Three out of four are civilians. About half of the people are assigned professional scientific and engineering duties. Sixteen percent of the military and 29 percent of the civilians have doctorate degrees, and 67 percent of all the professionals possess graduate degrees.

OAR physical assets are valued at approximately $95 million with $55 million in equipment and $40 million in buildings and real estate.

Four Phases of Research and Development

The Air Force research and development structure is divided into research, exploratory, advanced, and engineering development.

OAR is responsible for all of the research endeavors of the U.S. Air Force and a small segment of its exploratory and advanced research. Research funding within the Air Force amounts to 2.6 percent, or about $90 million of the $3.4 billion overall research, development, test and evaluation (RDT&E) program. The Air Force Systems Command (AFSC) manages most of the remainder.

In addition to the $90 million for research, additional funding for work in the exploratory and advanced portion of the research and development structure provided by AFSC and other agencies brings OAR's total funding to approximately $130 million. In an average year OAR will obligate $50 million for contracts and grants with 73 percent going to educational institutions, 23 percent to industry, and 4 percent to nonprofit organizations.

Air Force research efforts are divided into areas of physical, engineering, environmental, and life sciences. These areas, in turn, are divided into 13 sub-elements.

The physical sciences, which include general physics, nuclear physics,

chemistry, and mathematics, account for 35 percent of our efforts. The engineering sciences, including energy conversions, mechanics, materials, and electronics, total 33 percent; while environmental sciences, divided into atmospheric and terrestrial sciences, total 26 percent. The life sciences amount to 6 percent and include biological, medical, behavioral, and social sciences. Each of these areas is relevant to Air Force research requirements. Our research includes practically all areas of science with the exception of oceanography, which is exclusively within the Navy research program.

Planning Military Research

In the military, as well as in industry, a good research program starts with careful planning. The Joint Chiefs of Staff publish a Joint Research and Development Objectives Document which is distributed to each of the Military Departments and is necessarily very broad in scope. In turn, the Air Force publishes the USAF Planning Concepts document which looks as far as 15 years into the future. This document includes such items as technical horizons, analysis of the international scene, doctrines of concept, and desired capabilities. The staff of Air Force headquarters is assisted in the preparation of the plan by the field organizations: Strategic Air Command, Tactical Air Command, other operational commands, AFSC and OAR.

Using the Air Force plan as a guide, OAR publishes a Five-Year Plan which is revised annually, and includes in detail the organization, missions, resources, and scientific and technical efforts. It enables the OAR headquarters staff and subordinate commanders to carefully plan ahead and is an important part of research management. The Five-Year Plan is an internal publication with distribution limited to government agencies.

From the Five-Year Plan, the portion concerned with scientific and technical efforts is extracted and published as the OAR Research Objectives. This publication is widely distributed to educational institutions, nonprofit organizations, and industry. It provides information to help recipients present unsolicited proposals to the proper organization within OAR.

Individual research contracts and grants are generally small compared to the large sums expended on development contracts. OAR seeks to buy "brainpower" to supplement in-house capability. Contractors do not generally need large facilities to compete for this type of work. Research proposals are selected on the basis of relevance, originality, and the caliber of the principal research investigator.

Managing Research

Successful management of research calls for considerable background in research itself, in order to intelligently manage what is, in effect, a creative effort on the part of the investigator. We feel that OAR enjoys a good reputation in the scientific world, and this reputation itself assists management at all levels.

While we operate on the premise that research is primarily a search for knowledge and understanding, and to increase our stockpile of knowledge, in a military mission-oriented organization there is a more practical objective in terms of known or anticipated military problems. This is true at the management level, but is not necessarily always true at the investigator's level. We especially seek scientific areas that have strong military relevance and perform research to provide the technological base for further developments and future production of military equipment. Thus, in a very real sense, research management decisions of today have a critical impact in determining military operational capability some years in the future.

The fundamental characteristics of research differ markedly from those of development or production. Technical feasibility is unknown—in fact, it is the objective. Research is not a repetitive process, but a unique effort. The degree of success, time phasing, and costs can only be estimated since they are so dependent on scientific progress. Breakthroughs in research cannot be forecast with any degree of accuracy whatsoever. Thus, major management problems relate to such questions as which technical areas and scientific fields warrant further investigations; what studies, analyses, and investigations should be curtailed or deemphasized.

Since these kinds of decisions can be made most effectively at or near the working level, *i.e.*, the laboratory or project scientist, the fundamental principle of research management in the Air Force is the maximum delegation of authority. The primary management control exercised at Air Force headquarters and OAR headquarters is in terms of level of effort, such as allocations of resources to general technical areas or scientific fields, with broad authority delegated to subordinate commanders. They, in turn, delegate a considerable amount of this authority to their project scientists at the lowest level. Most operating decisions are made at project scientists' levels with broad general limits and within scope of available resources.

Resources are limited, and frequently management must decide among several desirable efforts—to say it another way, priorities, in the classical sense. However, one cannot make a list of all efforts, rank

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OFFICE OF AEROSPACE RESEARCH

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SCIENTIFIC	SCIENTIFIC SUPPORT
CAMBRIDGE RESEARCH LABORATORIES	EUROPEAN OFFICE
AEROSPACE RESEARCH LABORATORIES	LATIN AMERICAN OFFICE
FRANK J. SEILER RESEARCH LABORATORY	LOS ANGELES
AIR FORCE OFFICE OF SCIENTIFIC RESEARCH	VANDENBERG
OFFICE OF RESEARCH ANALYSES	PATRICK

them in order of priority, and then allocate available resources starting at the top of the list. In broad areas, of course, some rankings can be made but individual resources often are not interchangeable, and it is difficult to forecast the probability of technical progress, the ultimate impact of a scientific investigation, and the relative value of a research study versus an end-item development. Consequently, most resource allocation decisions must be made primarily on the basis of judgment, experience and intuition.

In the defense research sciences, which is the hard-core research program, projects are planned, documented, and resources are programmed in advance. In one sense, priorities are, of course, established in the allocations of funds each year to the various projects. A guiding principle, in this case, is to insure reasonable stability in these longer-term projects. Thus, to the extent possible, project needs are anticipated and provided for in advance.

Nevertheless, unforeseen contingencies do arise, particularly in a research-oriented agency such as OAR. Decisions have to be made or priorities must be established when a promising idea comes along. In each case, the probable value resulting from the proposed effort must be weighed against the potential loss from reduction in resources for other efforts. These problems may arise at any management level, but the level at which the decision is ultimately made depends on the scope and importance of the particular problem. Thus, although many decisions are made by project scientists by shifting resources available to them, in other cases the matter must be resolved by the laboratory commander, and sometimes must be referred to OAR headquarters or even Air Force headquarters for the final decision.

In addition to the hard-core research program, OAR does work for, and accepts contractual funds from, various government agencies within and without the Air Force. Normally, these efforts are relatively short term and result from a specific request from the sponsoring agency. Acceptance is subject to the approval of the laboratory commander, and the work must be in an area where the laboratory has a related program and scientific competence.

Also as a matter of policy, OAR encourages the participation of all of its scientists to support development and system activities in their particular fields of interest. Frequently, this support is limited to advice and consultation to the developing agency. Often, however, the work involves more detailed investigations or conduct of specific experiments and tests, and in some cases includes development and evaluation of end-item equipment for Air Force use.

Scientists in our in-house laboratories are encouraged to devote a substantial part of their time to developing an awareness of Air Force problems within their technical areas, and consulting with other Air Force elements and users of OAR research. This requirement is written into the job descriptions of all military and civilian laboratory professional personnel.

OAR is very conscious of its obligation to the operating Air Force. We believe that participation is the most effective means of coupling research results into development and production programs. In addition, the knowledge and experience gained by the scientists are invaluable in increasing their understanding of operational problems. This policy is essential to maintenance of a viable and responsive research program, and I consider it an excellent management tool.

As commander of OAR and a manager of Air Force research, it is my responsibility to have a strong interface not only with the scientific community, but also with the potential users of research and those concerned with long-range planning.

Interaction with the Office of Naval Research and the Army Research Office is frequent—if not daily. This interaction between Services takes place both at bench scientist and management levels, and also applies to other government organizations, such as National Aeronautics and Space Administration, Defense Atomic Support Agency, Federal Aviation Agency, and the National Science Foundation. Sometimes OAR participates directly in activities with the President's Scientific Advisory Council and the Federal Council for Science and Technology.

OAR representatives regularly attend Air Force Systems Command Planning Board meetings, the Director of Laboratories directors meetings, coupling meetings, and techical management conferences.

Monthly I personally meet with the AFSC Science and Technology Management Council, which is composed of general officers of the System Command, the staff of Air Force headquarters, and a representative of the Assistant Secretary of the Air Force (Research and Development).

The working relationship with the Directorate of Doctrine, Concepts and Objectives in the Office of the Deputy of Staff, Plans and Operations, in Air Force headquarters, involves effective person-to-person communication with a minimum of red tape. This communication enables OAR to contribute its scientific brainpower to long-range planning concepts and to projections of the technological world ahead of us. In return, we perceive in sharper focus where to pursue research.

Serendipity vs Managed Results

In some ways management of research may be likened to managing the unknown. Serendipity and research go hand in hand. An interesting example is the research of Nobel Laureate Charles H. Townes who, two decades ago, was studying the interaction between microwaves and gas molecules. To many investigators few areas of physics appeared to be less promising. However, Air Force management supported his work to the extent of $100,000. As is well known, the result was ultimately the maser and, later, the laser. Everyone, of course, is familiar with the laser, but few realize that Dr. Townes' maser research was essential to the development of the atomic clock, as we know it.

Another example of where we in research management could not forecast a payoff is a product of our continuing radio astronomy program. One Air Force contractor was studying the size and location of a very small galactic radio source. One way to get size information was to view the source from widely separated stations. Consequently, sensitive radio astronomy antennas were set up several thousand miles apart to receive

signals simultaneously from the radio source. These two stations made up an extremely long baseline interferometer. By knowing the precise size and location of the galactic radio source and the exact location of one ground station, the other ground station can be located to a precision far greater than any other geodetic technique—a capability which is very relevant to Air Force needs.

Knowing the exact distance between a launch pad at Vandenberg AFB and the impact area in Pacific is very important in the AFSC missile test program. Since interferometry is a technique that requires extremely accurate time synchronization between the receiving stations, the long baseline interferometer would be impossible without the atomic clock, which is so accurate that if one had been set properly more than 2,000 years ago its error would be less than one second today. This is an example of where research in quantum electronics by Dr. Townes and research in radio astronomy by other scientists was utilized to make a significant achievement with special relevancy to Air Force interests.

As it often is in research, the outcome of the two individual projects was not apparent at the beginning. Neither was the research of an English mathematician named George Boole who, more than a hundred years ago, invented a new algebriac system. As basic research it was a brilliant contribution to pure mathematics. It was logical, self-contained, and a new philosophic approach to the explanation of the universe in mathematical terms, but it seemed useless at the time. There were no problems available for it to solve. For nearly a century it was considered just another curiosity of interest only to mathematicians. It remained for another scientist, Claude Shannon, to write a technical paper in 1937 pointing out that Boolean Algebra could be applied to solve a whole new class of complex problems in the design of electronic circuits. The paper was read by Bell and perhaps even impossible to design a complex, high-speed computer circuit without Boolean Algebra.

Applying Research and Technology

Research breeds technology and technology breeds research. A novel, high-speed photographic technique employing a laser has enabled Air Force-supported scientists to gain new insight into the gasdynamics of explosions and, recently, revealed for the first time details of some of the phenomena which occur in rocket thrust chambers. This technique can yield nanosecond exposures (one billionth of a second) at megacycle rates —on the order of millions of frames per second. It permits scientists to not only see how something behaves, but offers new means to understand why it behaves in a particular manner. These studies centered around the fundamental properties of shock, blast, and detonation waves, in order to learn more about these processes. It is hoped to learn how to achieve better control over the explosion phenomena in weapons, as well as providing technology for far more powerful propulsion systems. Some typical questions being asked are: Can we drop a bomb and divert more energy laterally and less energy vertically? Can we provide a substantially higher thrust and greater stability in rockets?

As one leaves the fundamental research areas toward more applied aspects, setting of priorities can be done with greater confidence. In a few cases based on exigencies of the current Vietnam situation, research scientists with worthwhile practical ideas have chosen to follow them closer to hardware than they ordinarily would. One good example of this can be found in the low light level television area, where early concepts of the isocon camera tube approach had not reached fruition. Because of high priorities accorded the work by the research scientist concerned, by the laboratory, and with the encouragement of OAR headquarters, it was possible to pursue the concept vigorously and to compress significantly the time for development of improved tubes and cameras. This has allowed earlier evaluation of competing concepts and greatly advanced the state of the art in low light level television.

Another interesting example of research management to optimize application to Air Force interests is the work of Dr. James D. Winefordner, of the University of Florida, who has been working since 1965 with OAR support on flame spectrometry and gas chromatography. With this support the atomic fluorescence method of analysis of materials was discovered and brought to the present state of the art. This method appeared to have potential application in the Air Force Spectrometric Oil Analysis Program which is directed toward early identification of incipient failure or undue wear rates of oil lubricated mechanical parts.

The OAR project scientist suggested to the researcher that he devote a portion of his time to investigating this possible application of his work. Funds were added for this aspect of the project. With continued development, much progress has been made. The new method of analysis is now being evaluated in competition with the older methods of analysis of wear metals in aircraft lubricating oils. If expectations are borne out, atomic flame spectrometry could provide less costly, faster, and more accurate oil analysis. Not only would it save millions of dollars in aircraft maintenance, but it would also aid in preventing air crashes due to engine failure and the resulting loss of lives.

One critical area confronting the Air Force is the vulnerability of electronic systems to certain kinds of radiation. This problem exists today, and in the future there will be increasing demands for electronic components, devices, and systems that can operate effectively in the natural radiation environment of outer space, and in the severe environment produced by nuclear explosion.

About two years ago, OAR began investigating what could be done to solve the problem of vulnerability to radiation. Although some fundamental information was available from previous basic studies, it was apparent that there were large gaps in our understanding of the mechanisms of changes in solid state devices, the magnitude and nature of radiation damage, and how deleterious effects can be avoided in these hostile environments. Based on scientific competence in materials research in solid state physics, one of our laboratory directors decided

to organize a coordinated research program in radiation resistance.

A number of research efforts were phased out, or reduced in scope to obtain the necessary resources to initiate the program. The process continued and, as the program progressed, OAR received additional finanial support by AFSC. Because of progress in the investigation of radiation effects and the applications of these results in the development of electronic devices, solutions to some of the problems have been completed well ahead of schedules imposed by the using agency. We are optimistic about additional progress and solutions to other existing problems.

In these and other cases, the priorities were self-generated because of both the research area and Air Force potential requirements. The self-generated priorities are part of the Air Force research picture and, if the topics are of sufficient importance, often the scientists themselves will move toward exploratory development even at the expense of some of their other research. These informal arrangements help to optimize the organization's output even more than any formal priority system and act to preserve the flexibility so vital to research.

Sometimes there is a management decision to shift research emphasis in view of a request for support from the Air Force development laboratories. As an example, an intensive new research attack on problems of oxidation and corrosion has been initiated. This new program, which is being carried out in our Metallurgy and Ceramics Research Laboratory, is needed to guide development of alloys and protective coatings which are more resistant to oxidation, corrosion, and stress corrosion cracking. The losses to the Federal Government due to oxidation and corrosion have been estimated as high as a billion dollars annually.

This new effort is already providing regular inputs to AFSC's Air Force Materials Laboratory program to develop new, high-temperature, refractory structural materials, and is also relevant to the development of carbon and carbide fibers for advanced materials. Other research efforts within the ceramics program, dealing with the electronic, optical, and thermal properties of ceramics, are being reoriented to support the new effort with an interdisciplinary approach.

The very nature of the Air Force mission requires that all weapon systems operate within the aerospace environment and in this area research management gets involved not only in basic environmental research, but also in the exploratory and development research areas. OAR is responsible for all Air Force research in the environmental sciences which includes geology, geodesy, meteorology, upper atmosphere chemistry and dynamics, solar phenomena, and environmental properties of near space.

In order to conduct experiments in the atmosphere, it has been necessary that satellites, balloons and rockets and special instrumentation be designed, developed, and launched. OAR is one of the world's largest users of sounding rockets and balloons. Special fabrics have been designed for large research balloons and launching techniques perfected that have made it possible to launch 28-million-cubic foot balloons to an altitude of 160,000 feet. Balloons have been designed that can be recovered and used again. We have launched tethered balloons to an altitude of 10,000 feet and our goal is 100,000 feet. Balloons offer an economical method of getting a scientific payload to altitude. We presently can lift a 10,000-pound payload to 70,000 feet, and a 2,000-pound to 130,000 feet.

To date OAR personnel have launched over 375 scientific payloads aboard Scout, Cajun, Nike, and other sounding rockets as well as 7 deep space probes and 33 piggyback scientific passenger pods. In addition 40 plus satellites in support of research in the aerospace environment have been orbited and have provided vast amounts of new knowledge of the aerospace environment.

Every day research scientists learn a little more, always looking for the big breakthrough, but more often gaining new knowledge in small bits which combine and fit together in bigger pieces until the big breakthrough occurs. Management must realize that quality research usually cannot be hurried and breakthroughs cannot be directed. The business of understanding physical phenomena is an elusive process. There must be a certain amount of wandering along the boundaries of knowledge in the hope of learning some new phenomena.

Modern science is getting much too big and complicated for any one man in any one discipline to grasp completely. Critical research problems refuse to fall into neat disciplinary categories. In order to solve complex technical problems, the Air Force for many years has been conducting interdisciplinary research. Research managers will continue efforts which will lead toward more interdisciplinary research. However, at the same time, single disciplinary research must and will continue to flourish and will never be replaced by interdisciplinary research. The loner, the creative genius who works within his own isolated laboratory is definitely needed.

We in OAR believe we are doing a good job of research management, but we also believe there is always room for improvement. Therefore, to further enhance the capabilities of managing our resources, we have recently established a management research team. This team, which will perform basic and applied research in the resources management field, will hopefully be able to develop new techniques and methodologies that can be applied to the research community. We envision that through this type of research OAR, as well as other research agencies, will be able to increase its effectiveness and efficiency in performing research functions.

Army Engineer Budget Reduced in FY 1970 Revision

A $142 million reduction has been made in the Army Corps of Engineers' budget request for FY 1970. The Engineers' Civil Works program amounted to $1,020,135,000 in the President's revised budget, down from the $1,162,000,000 in the original budget submitted.

Changes made in the budget request included an increase of $500,000 for General Investigations, to provide funds for a Lower Mississippi Region comprehensive study, and a decrease of $142,365,000 in the Construction, General appropriation.

Eight new planning starts were added to the budget and four deleted, and a major rehabilitation project for the John Hollis Bankhead Lock and Dam, Ala., was added.

Designing an Integrated Logistic System

Brigadier General George C. Axtell, USMC

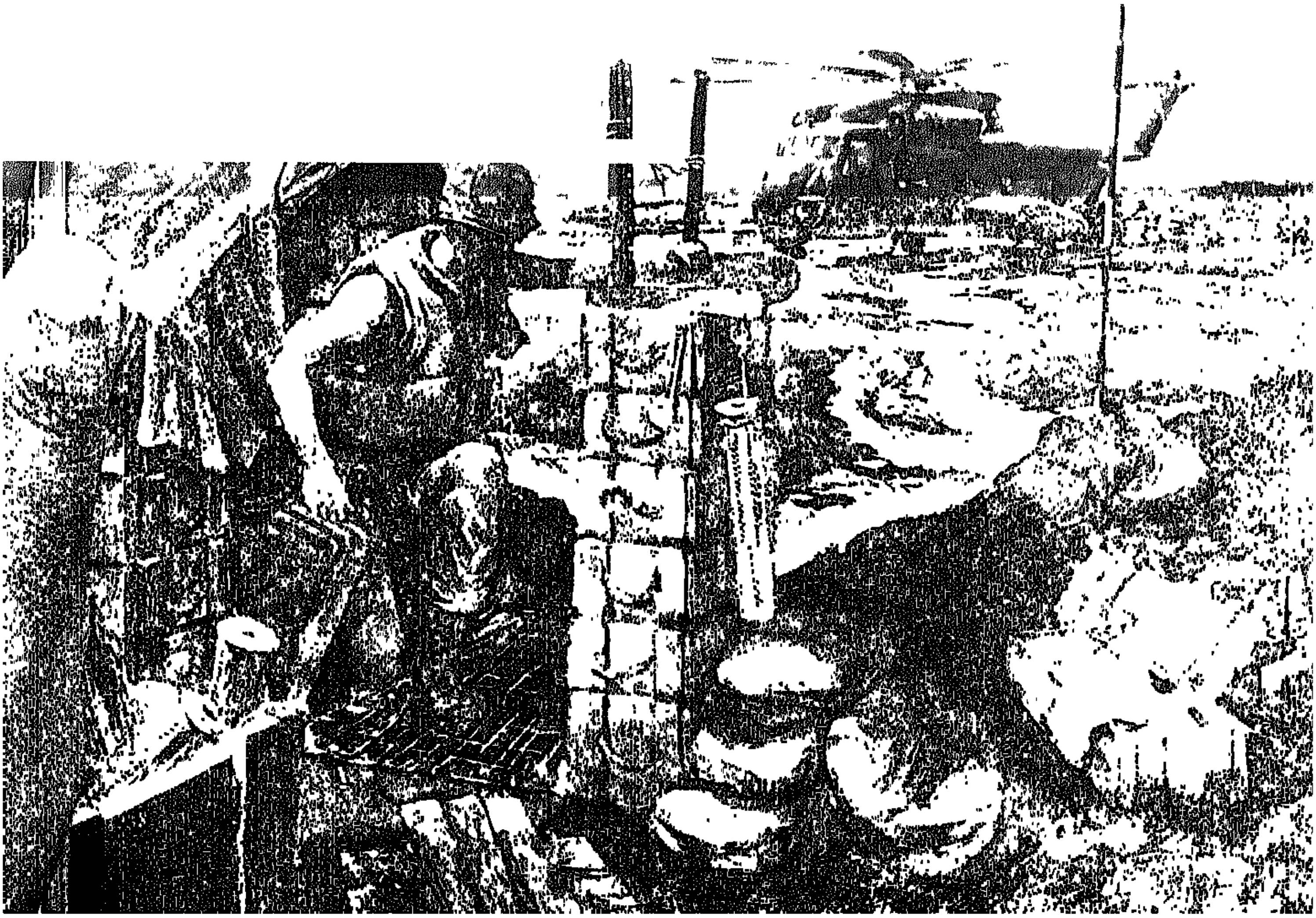
Integrated logistic support is inescapable. It always was. We are now more conscious of the process because all of the elements of support have been identified, and a formal systems approach to weapon support has been taken. Integrated logistic support (ILS) had to evolve because the sheer complexity of hardware demanded it. Now that it is here, officially and formally, and working, there seems to be something missing. ILS does an amazing job of integrating the requirements of the logistician with those of the equipment designer and operator. There remains, nevertheless, a problem of placing an item of equipment in service and keeping it supported—ILS or no ILS.

When equipments are placed in service, they must be supported by the Military Service's logistic support system. Decisions to buy parts, tools, publications and other items, as well as to distribute them, are made on the basis of each Military Service's support system. The result of this is that ILS decisions are influenced by the configuration of the logistic system in which the new equipment is to live. Are these systems adequate? Is there a deeper integration process that suggests more harmony and coherence between the elements of the system—prior to consideration of hardware decisions? These questions form the framework for this article.

For orientation purposes, answers to the posed questions are views expressed by Marine Corps logisticians. This, in turn, demands an appreciation of how a marine sees the process of logistic support from the national level. These views, observations and conclusions are expressed herein—not for the express purpose of suggesting that they be adopted, but rather to convince others that there very well may be an area of considerable potential for exploration.

G–4 Tasks in the Marine Corps

The Chief of each of the Military Services is responsible for the total logistic capability of his organization



to carry out whatever mission may be assigned in the national interest. The role of the Assistant Chief of Staff, G–4, the logistics officer of the Marine Corps, is that of the temporary custodian or trustee of the following tasks:

- To assure that the individuals, the units in the operating forces, the divisions, the aircraft wings, the combat support units, all obtain what they need.
- To propose and secure adoption of, in an evolutionary approach, that organization required to support these units, including the optimum maintenance and supply systems.
- To translate operational requirements into those directives and actions required to support the technical side of the research and development effort.
- To collect, assimilate and correlate information required to justify the resources needed for the procurement of equipment, and the funds required to operate and maintain the operating units.
- To audit the system in order to determine performance, anticipate problems, and seek solutions to deficiencies, whether they be managerial, technical, or other.

The Assistant Chief of Staff, G–4, as the advocate in Washington, D.C., for the consumer (the man in the field), has as his basic tools to accomplish the foregoing functions those of a manager in the most general sense: motivation of people, stimulation of ideas, keeping lines of communication open. In trying to keep the logistic organization of the Marine Corps oiled and operating, he must insure that resources are allocated in those areas where analysis indicates there will be a payoff in support capability.

All logisticians in the Military Services are cognizant of the need to field supportable weapons and to plan for their continued uninterrupted support, so as to insure a high level of operational readiness. There appears to be an incipient problem, however, in placing such precisely designed and supported weapons in service. Descriptors to identify the problem are difficult to devise. Perhaps the best representation of the impediment is to describe the process as one of placing weapons and equipments that *individually* have a highly disciplined support package into what appears to be an *undisciplined* logistic support system. As an explanation of this: the ILS process is a highly disciplined methodology for getting hardware into use and for keeping it useful for its life cycle. It is highly disciplined because it precisely charts the life cycle of an item of equipment, starting with concept formulation and finishing with retirement from service of the equipment, as well as describing the events that take place during sub-phases of the cycle.

Many Aspects of Logistic Support

On the other hand, the logistic support system can be described as a conglomerate of organizations, personnel, facilities and procedures necessary to provide the required logistic support. It includes supply, maintenance, transportation, medical and other routines, with many information networks—the bailing wire for keeping it together. The system is grossly lacking in the "harmony and coherence of its elements" that is typified by ILS. This is natural, since a number of co-equal activities, such as the business world, civilian transportation agencies, and the several agencies of the Defense Department, play significant roles in the total cycle. The logistic support system does not need a czar to rule it; it does require a capability to have a meaningful visibility of the total effort.

It is highly essential that logisticians establish and agree on a meaningful description of what a logistic support system *should do*. It is only in this manner that its performance and effectiveness can be measured. It is here we begin to gain some appreciation of the vastness, and the apparent vagueness, of logistics. Logistics means many things to many people. It is procurement; it is supply, it is maintenance, transportation and medical; it is all of these things and a myriad of others. As a matter of fact, a complete logistic support system, as a system, defies adequate identification except when related to the key word, SUPPORT. First, it is necessary to describe what is to be supported, including the array of environmental settings in which some specific group or task force of organizations, with their organic weapons, is to operate.

In describing the performance requirements of a logistic support system, the concepts of ILS may prove applicable to the software package (the entire logistic network needed by a Military Service to enable it to develop, produce, fight and sustain the equipment and weapons it is required to support).

At this point, it is prudent to briefly review ILS. ILS is ". . . a composite of elements necessary to assure the effective and economical support of a system or equipment at all levels of maintenance for its programmed life cycle." It has enabed logisticians to communicate with design engineers.

What Can ILS Do for the Manager?

ILS can provide the basis for the manager to tailor management planning of specific tasks, at the appropriate level of detail, for logistic support planning and integration. The looked-for end result is to insure that management actions integrate all support elements in order to maximize the availability of equipment and optimize support costs. Why cannot this same methodology work for the logistic support system as it works for hardware? An examination of the 10

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elements of support (maintainability and reliability, maintenance planning, support and test equipment, supply support, transportation and handling, technical data, facilities, personnel and training, funding, and management data) described in ILS reveals that they comprise most of the common basic elements of the total logistic support arrangement. ILS calls the support elements "things to manage." Some of these "things to manage" are supply support, maintenance planning, personnel and training, and transportation. These four of the ILS support elements were selected here to illustrate the point that these elements are all parts of a support package for a piece of hardware.

Each of the Services has developed its own supply operation, its own maintenance organization, its personnel support system, to some extent its internal transportation network, all of which fill a peculiar requirement to respond to the particular Service's ultimate objective of supporting an operational demand.

It is not expected that the logistic support systems of all the Services will be configured the same way; this is neither feasible nor desirable. For instance, the Marine Corps places heavy emphasis on the embarkation process to facilitate debarkation for the forceful entry of a landing force into a hostile area ashore from its seaborne base. This is not "called out" in ILS. However, the Marine Corps must consider the embarkation/debarkation process and treat these elements as part of the Marine Corps logistic support system. It is obvious that industry and the other Military Services have different peculiar elements that comprise a specific routine. Nevertheless, ILS has identified the 10 essential support elements which should be managed in relationship to a hardware program. As examples, the "supply support element" is managed in a supply organization; the "maintenance planning element," in a maintenance hierarchy.

It is now the job of the Marine Corps how best to design, for example, our amphibious supply system, our peculiar maintenance organization, our specialized embarkation ou- [illegible]

of accomplishing the foregoing task? Why do we want to do this? For the identical reason which has been stressed by the disciplines of ILS: to achieve a level of harmony and coherence between all of the elements of the system. Our supply scheme must relate to our maintenance concept; our logistic support personnel must be structured in organizations that tolerate fracturing or task organizing to accommodate a selected groupment of combat units for a specific mission. An independent development of a supply system, as an illustration, cannot be tolerated because the Marine Corps might not be willing to pay for a constraint it could place on tactical mobility. Because ILS is achieving the harmony and coherence of support elements, we should endeavor to see how this is accomplished and ascertain if the methodology is applicable to the logistic support system package.

Support of Amphibious Warfare

The following approach appears to be the most practicable and productive. First, there must be a description of what a logistic support system should do. We must be able to identify the contribution which logistics in its totality is required to make in support of amphibious warfare, *i.e.*, the logistic concept. The organization and methodology for the tactical application in support of an amphibious force deploying on an operation is well documented. We do not desire to design a logistic support system unto itself; it must satisfy a requirement and be responsive to something. The "requirement" and the "something" in the case of the Marine Corps is amphibious warfare.

At the outset, however, there must be a description of amphibious warfare. In looking at concepts of warfare, amphibious warfare as far as the Marine Corps is concerned, we find many elements that vary the concepts. For example, there are modes of assault, surface or vertical, and combinations thereof; there are environmental factors, such as would be found in operating over open beaches, operating close to the seashore, or those requiring a deep penetion inland. Further, we find a [illegible]ety of postulated tasks, such as [illegible] hold, patrol and block, [illegible]oy, and several others. [illegible]et Marine Force, in

accord with the statute, must be prepared to perform any mission which the President may direct, in addition to the classic amphibious assault mission.

Without attempting to influence the modes, environments and tasks of amphibious warfare (and our function, logistically speaking, is not to influence, but to be responsive), we can indubitably develop from these assumptions a "logistic system concept." This would be an extremely broad set of logistic support objectives designed to match the concepts of warfare. It would be similar to the concept formulation phase for a new weapon. Further, it is the same technique used in the ILS process, wherein the logistician talks to the design engineer, except here the logistician is utilizing that very discipline in his contacts with the operational commander.

With an amphibious warfare concept paper and a companion logistic system concept document that is structured on the basis of supporting a concept of warfare which takes on many images, it is, or should be, a relatively easy undertaking to proceed with system developmental action as suggested by ILS. The logistic system concept phase has already been equated with the concept formulation phase. A "logistic system specification" is acquired to define precisely what is required of a maintenance organization, a transportation scheme, a command and control system. This could be likened to the contract definition phase in hardware development procedures.

So far, three phases in the logistic system development process have been identified. It is critically important that these phases, and those that follow, be integrated; *i.e.*, the products of each phase should be used to validate the actions before that stage and to provide direction to subsequent ones. Further, personnel responsible for one phase must be afforded the opportunity to participate actively in other phases. This is one of the key issues involved in ILS.

In engineering a logistic support system, the next phase is the development portion. This is equatable to the normal weapon development phase. In this realm we can establish exactly what is needed in the logistic support system and how the changes are to be made. The normal weapon

production phase can be called the logistic system modification phase. Although this is not a true production phase, the authorized changes to the logistic system which are being effected are synonymous with production. The final phase in readying a logistic support system is its operational feature. As we do with our weapons, we must maintain constant watch on our total system performance and feed performance data back to the designers and, above all, to the operational commanders responsible for execution of the warfare mission.

Sixth Phase—Warfare Concept Definition

The foregoing is a depiction in rather brief form of a conceptual link between the phases of weapon system design, development, and production, and the design of a logistic support system. Our weapons are assured of the proper management during the development and operational stages. It is not at all certain that the same degree of attention is provided our support systems.

These formulations applied the five life-cycle phases of hardware to the software problem. Also, it has been suggested that the same anaytical approach should be taken to solve the apparent disorder in logistic systems. A sixth element can be added, one which precedes all others; this is the warfare concept definition phase. For clarity, a recapitulation of this process is inserted here.

The logistics support system should be designed after an in-depth analysis of the warfare concept. It is only after this analysis has been made that specific logistical needs are identified and provided. Following the weapon life-cycle phases we, then, have the following tasks to complete:

• In lieu of concept formulation, develop a logistic system concept; this will be the architect's pencil sketch of the system, with details to be worked out later.

• In lieu of contract definition, develop a logistic system specification; here we introduce a degree of precision in what is required, and start to fill in details of performance and of the aims of the system.

• Proceed with the logistic development phase by applying the principles of the weapon system development phase; we are now attaining increased precision, and are developing specific production prints as to what the system is to accomplish and how it is to operate in accordance with identified procedures.

• Substitute the logistic system modification phase for equipment production; at this point we actually make changes incrementally in the system, as fast as personnel can be trained and managers converted to the new philosophy or cult, by installing a new maintenance routine, a data network, a modified supply system, etc.

• Retain the normal equipment operational phase; however, we must monitor and audit the performance of this universe rather than the hardware.

If this process just described is to gain acceptance, it must contain significant tangible payoffs. They appear to be there. For illustration purposes, it is difficult to conceive that a maintenance concept can be designed without attendant identification of what the tolerances for maintenance in any selected warfare mode would or should be. Additionally, there is the problem of how to identify the tradeoff that can be made in a supply system on the basis of alternative maintenance schemes. How can a logistic study program be conducted without full knowledge of the objective of a total logistic support system? Many more questions could be asked that caution against taking small bites at our logistic system deficiencies and against developing fixes which are resolving only minor difficulties. It all sums up to the requirement for the Marine Corps to remain conscious of the in-house need to have someone responsible for watching and scheduling the complete system design.

The ultimate results of a systems engineering approach to our logistic system, regarding all of its parts related to a common objective, should accomplish the very same thing that ILS has done for equipments. This is an unusually simple objective and can be paraphrased from the definition of ILS. It will "provide harmony and coherence" of the logistic system elements. It will balance the need for change to any part of this logistic universe, with full consideration being given to the effects of the change on other parts of the system. Above all, it will consider our capability and capacity to change. For example, a new supply arrangement will not make a contribution until there exists a demonstrated and proven case that the new methodology is absorbable. This refers to the ability of the personnel who will use the system to understand what it is and how it is supposed to function, from the private up to the general, with emphasis on the general.

The process herein described appears to offer an exploitable opportunity for logisticians to look macroscopically at what they are responsible for. We must be able to motivate ourselves into taking a broad look at our systems and seek an objective discipline to our approach to change. There is, fortunately, a rather plain and unsophisticated objective. The logistician should identify the postulated warfare concepts to determine their impact on his role, then develop a series of logistic support concepts and plans and, lastly, identify the resources which are required to support the plans.

Too much emphasis cannot be placed on the fact that operational commanders must be furnished logistic support options. With the various modes of warfare, warfare tasks and environments incumbent on the Marine Corps, no single system is going to be optimum for all. We must have alternative and redundant systems ready to offer.

Something for all of us to remember, even logisticians, is exemplified by an excerpt, amphibious warfare oriented, from the diary of General Sir Ian Hamilton at Gallipoli in April 1915.

> **. . . At home they are carefully totting up figures—I know them—and explaining to the P.M. and the senior wranglers with some complacency that the 60,000 effective bayonets left me are enough—seeing they are British—to overthrow the Turkish Empire. So they would be if I had that number, or anything like it, for my line of battle. But what are the facts? Exactly one half of my "bayonets" spend the whole night carrying water, ammunition and supplies between the beach and the firing line. The other half of my "bayonets", those left in the firing line, are up the whole night armed mostly with spades digging desperately into the earth. Now and then there is a hell of a fight, but th- dental and a relief.**

(Continued on p

System/Cost Effectiveness Analysis in the System Engineering Process

Colonel Donald H. Heaton, USAF

The increasing cost and complexity of today's weapon systems to fulfill military missions have brought into sharp perspective the need for a system discipline, capable of providing for total systems tradeoffs and greater visibility to management through integration of system engineering requirements. A general recognition of this need led the Air Force Systems Command to establish the Weapon System Evaluation Industry Advisory Committee (WSEIAC) in 1963. Summarily, the objectives of the WSEIAC were to review the current state of the art of system/cost effectiveness analysis, develop proper foundations for system/cost effectiveness concepts and, in general, to make recommendations pertinent to the technological needs of the discipline. The WSEIAC report has served as the foundation for our system/cost effectiveness activity since its publication in 1965.

In the Air Force Systems Command, we view system effectiveness analysis as an integral part of the system engineering process for managing the technical definition of a system and the technical program for its design, development, test and evaluation. System engineering is the engineering planning and control process which insures the completeness, integrity and optimization on a complete system basis of the definition products, consisting of performance specifications for the system and plans for all elements of the development, test and evaluation program. Specifically system effectiveness analysis aids the evaluation process of system engineering to determine the optimum choice among technically feasible alternatives from a mission performance point of view. Cost effectiveness analysis, then, is the companion technique for relating total system effectiveness to life-cycle cost. In essence, the combination of system and cost effectiveness analysis is the "heart" of the system engineering design optimization process. We have established this role for system/cost effectiveness in a new military standard for System Engineering Management. This standard is a part of the DOD System Engineering Management Project, recently initiated by the Director of Defense Research and Engineering, and is being developed by the Air Force in a "lead Service" role.

System effectiveness is a quantitative measure of the extent to which a system may be expected to achieve a set of specific mission requirements. The WSEIAC suggested that effectiveness be expressed in terms of a figure of merit, a measure of effectiveness in the form of a simple statement of mission objectives to which quantitative system requirements can be related. Some examples of such figures of merit are probability of success for a single sortie, ton miles/year, or number missiles on target per squadron per strike.

The WSEIAC further concluded that system effectiveness is a function of system *availability*, *dependability* and *capability*. This concept is altogether valid. It is an excellent framework around which to develop an analysis which encompasses the entire problem of operational and support effectiveness. The analysis must consider all those system characteristics that impact these system attributes.

Simply stated, capability represents the mission performance of the system in its natural and combat environment if all subsystems function to then specified values.

Availability is what the word implies: the state of operational readiness of a system when called for a mission. For an aeronautical system, for example, availability is obviously a function of the condition in which an aircraft returned from its last mission or whether it returned at all. This state depends largely on the reliability of its elements and its survivability in the enemy environment. Given a particular state on return, its availability for the next mission further depends on aircraft maintainability and the support subsystem characteristics, such as the supply and placement of spare parts, ground support equipment and maintenance skills and, of course, the time before next mission call-up.

Dependability, then, completes the picture, by contributing the likelihood that a system, once available, will perform up to its specification level, *i.e.*, up to its capability. It is largely a function of reliability and in-flight maintainability, if provided. Thus, availability, dependability and capability provide the framework for

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determining the interrelated impact on figures of merit of all technically achievable system characteristics, and for enabling the identification of best or optimum combinations, each of which has associated with it a set of life-cycle costs.

Similarly stated, cost effectiveness is a measure of the value received (effectiveness) for resources expended (cost). Cost effectiveness has, unfortunately, taken on an aura of economy first, military effectiveness last; rationalization or procrastination in the initiation of needed new systems; and penny-wise, dollar-foolish decisions in general. Despite such bad press, cost effectiveness is an analytical tool, indispensable in today's world of enormous defense costs and technically complex, interrelated systems. It can be misused; however, it need not be.

Properly employed, system effectiveness analysis is first applied to identify preferred combinations of characteristics of the capability type, which will not preclude subsequent optimization on the basis of all system effectiveness characteristics and cost. The analysis next is extended to include the availability and dependability parameters, and life-cycle cost analysis is applied to identify the total program costs associated with each combination. The optimum combinations, obviously, must be identified from the results of both analyses.

Both system effectiveness and cost effectiveness analyses make use of analytical models to mathematically represent the system being analyzed, its operating characteristics, and the concepts of its tactical operation and support. These models are normally structured so that any parameter, or combination of parameters, can be varied to determine the relative effect on total system performance (effectiveness) and life-cycle cost. Generally, these models are computerized. This is a necessity for complex systems due to the large number of variables and large quantity of data involved.

Admittedly, system/cost effectiveness analysis has limitations attributable to its system effectiveness and cost analysis components. Perhaps the most pervasive limitation is in our ability to accurately forecast the effort (and, therefore, the cost) required to achieve a set of specified system characteristics in a developed product. A further limitation is our inability to link the support actions and costs of systems, subsystems and equipment in a way which will enable dependable extrapolations of this experience to set design goals for the support characteristics of new systems.

Another particularly troublesome limitation is in predicting the enemy environment (threat) consisting of weapons, strategy and tasks with which our combat systems, and especially our manned systems, must cope. In such cases the capability factor is far from precisely determinable, and yet it is vitally important since a second-best combat system is not a very effective system. These limitations result from a combination of shortages in data and our inability to construct models truly representing the features of a future "real world" which should drive design and program emphasis.

However, each of these limitations is subject to reduction through deliberate effort. One of the best ways to develop such an evaluation tool is by applying it to programs, using great care to attribute only such confidence to its answers as is warranted after analyses to determine program limitations in a given case. Such an analysis estimates the margin of error in the values and relationships involved in an application, determines the sensitivity of conclusions to these values and relationships, and determines whether the potential errors can alter the conclusions reached from applying the process.

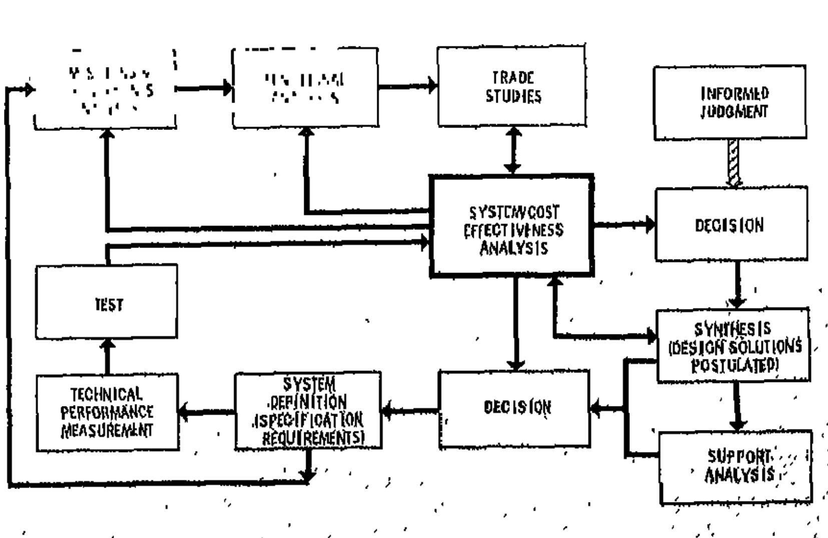
Because of such limitations, system/cost effectiveness analysis should be used as an aid to decision making. It should never replace judgment. It is, however, a potentially invaluable evaluation tool for the decision maker throughout the life cycle of a system. The analysis must be attuned to support the decisions that have to be made during the various phases of system development and production.

Conceptual Phase

System definition during the conceptual phase is properly devoted primarily to the identification of performance features for optimum system capability, such as payload, speed, navigational accuracy, radar range, etc. Correspondingly, system effectiveness analysis during the conceptual phase principally supports the capability optimization process. In determining systems capability parameters, system planning must seek to avoid precluding the later determination and achievement of optimum values of reliability, maintainability, and other design performance features which govern system dependability and availability.

Also during this phase, operational and logistic concepts and data should be developed from which system effectiveness and life-cycle cost models can be constructed for subsequent use in engineering development which encompass all three ingredients of total system effectiveness—availability, dependability and capability.

SYSTEM ENGINEERING PROCESS



These models should preferably be provided to the contractors, competing for engineering development contracts, with instructions that they be further developed and employed in determining the quantitative values to be proposed for development specifications, and the planning of program effort.

At the very least, sufficient guidelines and data should be provided to contractors for their development of models to optimize the dependability and availability features and specification values to be included in their proposals. To do so requires that, during the conceptual phase, the operational concept for the system be developed and, in turn, the logistic support concept be derived and sufficient program planning accomplished to provide a basis for the development of life-cycle cost estimates. The determination of firm quantitative values of system and subsystem reliability and maintainability, and other measures of logistic supportability, plus the specifics of the test effort to demonstrate these qualities, should be left for the contract definition phase; or if a definition phase is not carried out, then in the course of early engineering development.

One of the most important contributions the conceptual phase can make to system availability and dependability is to assure that total acquisition program costs are projected, to include as valid estimates as can be developed of the effort necessary to define, attain and demonstrate availability and dependability. It is a fact that in no systems to date have system availability and dependability competed technically with capability for influence on design performance features. However, it is entirely possible, and even desirable, that these qualities should compete technically subject, of course, to performance, physical cost and schedule constraints which are "givens" in the optimization process following engineering development effectiveness on a complete system life-cycle cost basis. Correction of this imbalance is a major purpose of the Air Force efforts to include cost effectiveness analysis as a tool in system and program decision making. It is also one of the primary reasons for integrated logistic support as a planning and acquisition program requirement.

Definition Phase

One purpose of the definition phase is to define the system and acquisition effort in sufficient detail to support a prudent commitment by Government and contractors to enter into whatever type of contract, *i.e.*, development, test and evaluation, or development plus production, is contemplated. A second purpose is to select the competing (or sole source) contractors who will conduct the first step of hardware development, beyond conceptual phase activity leading toward an operational system.

Ideally, contractors will be provided system and life-cycle cost models, representing the mission or mission mix and relating system performance and physical characteristics to figures of merit for the system. As stated before, system constraints will be of the capability type. Availability and dependability, and some capability parameters, will be dependent variables to be optimized by contractors using the models they were provided to the extent they are useful. Contractors will expand the models to represent their proposed system designs. The models and the system specification which they receive with the request for proposal will be baselined, *i.e.*, subjected to configuration control by the Government. However, any time in the course of further definition and allocation of performance requirements below the system level a contractor determines that either the model or specification does not truly reflect announced government program goals, he is urged to propose a
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ıese values should be the products of life-cycle cost effectiveness optimization of alternative values arrived at through application of a system engineering process which satisfies the MIL-Standard (now a draft) on System Engineering Management.

Decisions among open capability alternatives require finer distinction than those made in the conceptual phase. In fact in some cases, especially for manned, multiple-mission combat systems, the "model gap" referred to herein will not provide a completely reliable analytical basis for validating the system performance and physical requirements decided on in the conceptual phase. The modeling deficiency, in such cases, will be in relating system performance parameters to figures of merit, so that the figures of merit are sufficiently sensitive to variations in the parameters to be of particular value in source selection or in the application of performance incentives. Even when this relationship between system figures of merit and system performance is of questionable utility in validating such values, models for the allocation of these values to subsystems and components are within the state of the art. As we shall see, such "parameter dependency relationships" are useful in determining the seriousness of technical deficiencies which occur in the course of the program.

We are usually better off in the optimization of availability and dependability parameters than of capability parameters. For one thing, increased reliability and maintainability will always enhance system effectiveness, until the technical measures required to achieve the increased levels begin adversely to impact system capability. (As stated previously, I know of no case where this has happened, but it could.) The same is not true, however, for cost effectiveness. Cost tradeoffs must be made between higher development and unit production costs on one hand, and operational phase logistic support savings on the other. This situation is quite amenable to cost effectiveness analysis.

In this phase of system development, the contractors can be expected willingly to use cost effectiveness techniques since they represent not only an overall effectiveness requirement, but the government's desire for increasing performance while reduc-

ing cost. This is strongly reinforced by the fact that the contractors are normally in a competitive environment.

Acquisition Phase

Ideally, all elements of the system would be described in terms of performance specifications during the conceptual and definition phase, *i.e.*, before the development contracts are awarded and, in Air Force parlance, the acquisition phase begins. If this were practical, our development contracts would represent a complete meeting of the minds between Government and contractors on the performance and key physical characteristics of all of the products to be developed.

It is, unfortunately, not practical to define these "design-to" and "test-to" operations for all elements of the system before development is begun due to the sequential nature of the process. For example, the requirements for ground equipment and training programs depend upon the details of the solution to the design problem presented by prime equipment performance specifications, and these solutions are products of the development program. Therefore, the new system engineering management standard requires that system and cost effectiveness analysis be employed to aid in the optimization of the system design requirements and program planning which, of course, goes on during acquisition. The use of system and cost effectiveness analysis is not only required by the new standard to complete the optimization of the system as initially defined; it is also to be employed in the planning and selection of the engineering and technical program changes which are proposed during the course of the acquisition program. These are the types of changes required to overcome or work around technical problems or funding limitations, to adjust to changes in the military problem, to turn new technological possibilities to advantage in terms of increased mission effectiveness, or to accomplish net reductions in life-cycle cost.

Finally, during acquisition, one of the byproducts of system and cost effectiveness analysis enhances the fidelity and timeliness of Technical Performance Measurement (TPM). TPM is a new set of words to describe an element indispensable to engineering and program management. The System Engineering Management Standard merely sets a standard of contractor performance of this element of engineering management. TPM is nothing more than the design assessment function carried out through test and engineering analysis. TPM does not include the identification of the possible cures and the choice among them—the use of cost effectiveness analysis to help in this optimization process described in the preceding paragraph. In TPM, it is the existence of the parameter dependency relationships during the initial definition of systems requirements which comes in handy. The System Engineering Management Standard requires that contractors know at all times when a technical variance is occurring at all levels of design that will impact contractually specified requirements. Parameter dependency relationship enables a quantitative impact by such anomalies, on system level performance parameters and on system figures of merit, to be quickly and accurately determined.

Two other important facets of the application of cost effectiveness analysis during acquisition called for in the System Engineering Management Standard must be understood. One is the statement that this optimization tool should be used only to the extent it can "cost effectively" contribute to a particular decision. Simple decisions should not employ unnecessarily complicated or sophisticated evaluation methods. We do not want to create a supercult in system engineering management or in its cost effectiveness ingredient. However, the existence and probable implementation of comprehensive computerized system effectiveness and life-cycle cost models can forestall the costly sub-optimization which often results from too shallow an analysis or "horse back guesses."

The second point has to do with the fact that the powerful incentive of competition is lost when acquisition contracts are awarded. During the competitive source selection phase, as discussed before, contractors are motivated to outdo themselves to give us what we want, and one elequent way of doing this is through effectiveness and cost models. However, with the advent of the acquisition phase, the scene changes. Now contractors are motivated to minimize their risks and maximize profits under their contracts. Contractors will develop profit models and use them in the decisions which are within their prerogatives. It is entirely possible that a profit model will identify a decision which is "optimum" for a profit point of view, but which is in conflict with government interests as indicated by the use of system effectiveness and the life-cycle cost analysis. The System Engineering Management Standard recognizes this real-world possibility, and requires the contractor to advise the Government of any such conflicts which occur between contractor interests under the contract and government interests as revealed by system and cost effectiveness analysis. This will afford the procuring agency an opportunity to reassess its requirements and possibly pre-empt the contractor's decision. Obviously, when the procuring agency chooses this option, it must be prepared to accept whatever reduction in contractor responsibility follows as a consequence under the terms of the contract. Certainly, it is in the best interest of the Government to have this flexibility.

Operational Phase

Historically, we have always been faced with decisions relative to new or revised system usages (missions) and hardware modifications after the system becomes operational. For this reason, system/cost effectiveness analysis should be continued and models maintained into the operational phase. They will be most useful in making these decisions.

In summary, system/cost effectiveness analysis is considered to be a discipline with a real future. Its selective application to new programs is justifiable by its potential for improving the validity of program decisions and the efficiency of our decision-making process, plus the fact that only through application can we assess and overcome its limitations as an instrument to assist in rational decision making. Yes, we have problems, not the least of which is the acceptance of the discipline by some of our engineers and managers, and the shortage of qualified personnel to support the analytical process. We are devoting a growing portion of our resources to overcome such problems and, in time, I am convinced we will have them resolved.

MIL-STD-785A

Revised Standard Establishes Requirements for Reliability

George S. Peratino

Early in the 1960 decade, the need for mission responsive military systems and equipment brought about the development of Defense Department policy that would assure the development and production of reliable weapon systems.

Following the issuance of DOD policy, the Military Departments initiated procurements, including numerical reliability requirements and provisions for demonstrating attainment of the reliability. This required the preparation and submission by industry of proposed reliability program plans when responding to Requests for Proposals. To avoid the submission of individual creativity in the reliability programs received from each bidder, DOD appointed a departmental task group to develop a military standard for guidance in the preparation of reliability program plans. The DOD task group developed and obtained major military commands' approvals of MIL-STD-785, "Requirements for Reliability Program(for Systems and Equipment)." Industry association comments were also solicited and considered in the preparation of the final version of the standard, and MIL-STD-785 became effective on June 30, 1965.

The application of this embryonic standard by industry was met with mixed emotions. This prompted the re-establishment of the DOD task group for development of a revision to the existing standard that would be favorably accepted by industry. Initially, the task group explored areas of weakness and controversy in MIL-STD-785. Preparation of a proposed draft revision resulted that was circulated to all major commands of the Military Departments for comment and/or approval. After review of the major command comments, a new draft of the revision was prepared.

On Oct. 10, 1968, the draft revision was submitted to the Electronic Industries Association (EIA) and the Aerospace Industries Association (AIA) for review and comment. EIA and AIA comments were received by mid-December 1968. The final draft of MIL-STD-785A has been approved by the Office of the Director of Defense Research and Engineering, and is now available from the Naval Publications and Forms Center, Philadelphia.

Provisions of the Standard

Major points of interest to those affected by the provisions of MIL-STD-785A are:

- The standard is applicable to all DOD procurements. In addition, it shall be utilized on government in-house development and production of systems and equipment.
- Each contractor is required to establish and maintain an effective reliability program to permit the most economical achievement of overall program objectives. The program shall assure reliability involvement throughout all aspects of the design, development and production to meet the contractual reliability requirements.
- Mission responsive reliability requirements and objectives of the system/equipment shall be specified contractually. Quantitative hardware reliability requirements for all major subsystems and equipments shall be included in appropriate sections of the system and end item specifications.
- Achievements of minimum acceptable hardware reliability requirements shall be demonstrated by means of tests and analyses as required by the contract.
- The reliability program shall be coordinated with other interfacing efforts, such as maintainability, human resources, safety, quality assurance, standardization, systems engineering, configuration management, and integrated logistic support, to assure an integrated and effective contractual effort.
- The reliability program plan shall stipulate methods for assuring that the subcontractor's and supplier's reliability efforts are consistent with overall system requirements. Provisions are made for source selection of subcontractors and suppliers, and surveillance of their reliability activities.
- A reliability analysis of the system/equipment shall be initiated at the start of the contractual effort. This analysis should be an integral part of the overall system/equipment analysis which is conducted to obtain a balance between effectiveness, schedule and total resources. The standard contains a suggested approach for conduct of the reliability analysis.
- Parts which are described in military specifications, having established quantative reliability requirements (failure rate levels), shall be used whenever possible. Parts application criteria shall be established to control

George S. Peratino serves as Assistant for Reliability Matters in the Directorate of Procurement Policy, Office of the Deputy Chief of Staff (Systems and Logistics), Headquarters, U. S. Air Force. He is responsible for the development and implementation of Air Force reliability policy and management procedures to attain mission responsive weapon systems. Mr. Peratino holds a B.S. degree in electrical engineering from the University of Maryland.

selection of parts. The best available estimate of a reliability index, under the applicable stress levels, shall be assigned to each part, component, or subassembly. Available data and central information facilities shall be utilized to avoid needless duplication of testing.

• A failure mode and effect analysis shall be performed to identify potential system weaknesses. Each potential failure shall be evaluated to determine its effect on mission accomplishment and ranked as to its criticality. Mission critical failures shall be further investigated as to failure mode to determine design improvements required for elimination of failure causes or reduction of risks to acceptable levels.

• Reliability critical items are those items, the failure of which significantly affect the ability of the prime item or system to perform its overall function. The contractor shall establish a program for identification, control, and special handling of critical parts, components, subsystems, or other items from design through final acceptance.

• Reliability design reviews shall be conducted at appropriate stages of development and production to evaluate achievement of the reliability requirements.

• An integrated test and demonstration plan shall be prepared and submitted for approval by the procuring agency. The test plans contained in MIL–STD–781, when applicable, shall be applied. The test program shall be integrated with other system/management tests to avoid costly duplicate testing.

• Functional environmental testing shall be conducted during design and development phases to estimate achieved reliability and to provide feedback of data as a basis for making reliability improvements.

• The contractor must have and shall require subcontractors also to have a closed loop system for collecting and analyzing all failures that occur during in-plant tests, and those that occur at installation or test sites prior to turnover to the procuring agency. The failure reporting system shall be compatible with the procuring activity data collection system so that as the system nears the operational inventory phase, transition to in-service failure reporting can be accomplished with minimum disturbance and maximum continuity of effort.

• For reprocurements of systems/equipments, the procuring agency shall specify the minimum acceptable reliability requirements and appropriate demonstration requirement, and indicate those reliability program elements of MIL–STD–785A applicable to the specific procurements.

Actions by Military Services

Air Force reliability policy is contained in Air Force Regulation 80–5, "Reliability and Maintainability Programs for Systems, Subsystems, Equipment and Munitions," which has been revised to incorporate provisions for applying the requirements of MIL–STD–785A. The Air Force Systems Command (AFSC) is responsible for determining the scope of reliability and maintainability programs necessary to achieve system equipment requirements. AFSC must specify the program elements from MIL–STD–785 and MIL–STD–470 that the contractor must include in his program plans or response to the Request for Proposal.

The Navy policy for reliability of Naval material was initially established in January 1966 and is contained in SECNAV Instruction 3900.-36. Navy experience in reliability programs plans has been incorporated in the new MIL–STD 785A, and the next revision to the aforementioned SECNAV instruction will incorporate the provisions of the new standard for relibility program plans.

Within the Army, reliability programs in accordance with provisions of MIL–STD 785 are required in all contract definition, development and production contracts. This policy is established in Army Regulation 705–50, "Army Materiel Reliability and Maintainability," and is administered by all Army materiel development agencies. No change in this policy is anticipated as a result of MIL–STD–785A superseding MIL–STD–785.

Industry's Role

Industry must gear its management operations in order to comply with the guidance contained in MIL–STD–785A. Care must be exercised in the preparation of the reliability program plan to assure that the plan contains all information to make it responsive. Failure to do so could result in the rejection of a contractor's response to a Request for Proposal.

Contractors who have need for pertinent documents, published by the Military Services, should submit their request through their cognizant DOD contracting agency. MIL–STD–785A can be obtained from the Naval Publications and Forms Center (formerly Naval Supply Depot), 5801 Tabor Ave., Philadelphia, Pa. 19120.

Army Expands R&D Role of Corps of Engineers

Research and development authority and responsibilities of the U.S. Army Corps of Engineers have been expanded and stated more precisely by a new Army Chief of Staff Memorandum.

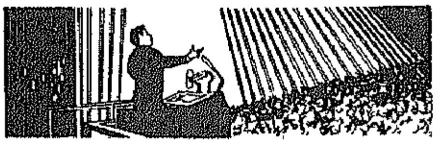
Under the general staff supervision of the Chief of Research and Development, the Chief of Engineers is charged by the Chief of Staff Memorandum with the following missions:

• Accomplishing research, development, test and evaluation (RDT&E) projects, including basic and applied research required for the engineer mission as assigned, and providing research and development support to the Army, Air Force, National Aeronautics and Space Administration, and other government agencies as required.

• Establishing requirements and performing research and development necessary to provide new construction design criteria, construction techniques, construction material, and facilities maintenance for the Army, Air Force, and other government agencies as required.

• Technical supervision of research and development of engineer techniques and equipment required for combat and combat service support.

The memorandum also prescribes all other aspects of the mission of the Corps of Engineers. Included are the Civil Works Program (now funded at about $1.3 billion annually), all military construction, the Army Installation Master Planning Program, Army Real Estate Services, support to the Assistant Chief of Staff for Intelligence pertaining to mapping and geodetic activities, and responsibilities under the supervision of the Assistant Chief of Staff for Force Development, Deputy Chief of Staff for Military Operations, and Deputy Chief of Staff for Personnel.



FROM THE SPEAKERS ROSTRUM

Defense Management Challenges—Deputy Secretary Packard Comments

Address by Hon. David Packard, Dep. Secretary of Defense, before the Aerospace Industries Association, Williamsburg, Va., May 22, 1969.

I am pleased to be here this evening. I have been at the Pentagon long enough now to learn about some of the problems—at least I have learned that there are some problems.

The Defense Department presents one of the most demanding management challenges in the world. Continued improvement in this management will be one of the primary objectives of this Administration.

We can identify three different types of problems facing DOD. The first problem is to determine the tasks that are to be performed by DOD. The second problem is to determine the forces that are required to accomplish these tasks. The third is to procure and operate those forces in the most efficient manner.

Determining DOD Tasks

The first of these problems, defining DOD tasks, is the subject of an extensive study for the National Security Council.

There are two questions of great importance involved here:

- Do we have the military force structure adequate to support U.S. commitments around the world?
- What military budget level will the people of the United States support over the next few years?

Both of these questions depend on the turn of many events, both international and domestic.

We in the Defense Department have been working on this problem over the past few months. We touched on it in our budgetary reviews. We are participating in the inter-agency study for the National Security Council (NSC) which will permit NSC to make a decision on the military tasks that must be performed to support U.S. interests in the world. This study must recognize the cost of various tasks that might be performed, and I believe must also recognize that this country's post-Vietnam military budget must withstand the most searching and critical analysis.

This does not trouble me too much because I am sure we can get more defense for our dollar.

And we are working on this problem within the DOD with the hope that we can develop better procedures on which to build our budgets for the future.

This work has resulted in better communication between the Services and the Office of the Secretary of Defense, though I would hasten to add that conflict has not been eliminated—if it ever will be.

A major factor will, of course, be the level of the force structure. Barring another international involvement by the United States somewhere else in the world, the force structure can come down after Vietnam. These studies by the National Security Council will be the major influence in determining the post-Vietnam force level.

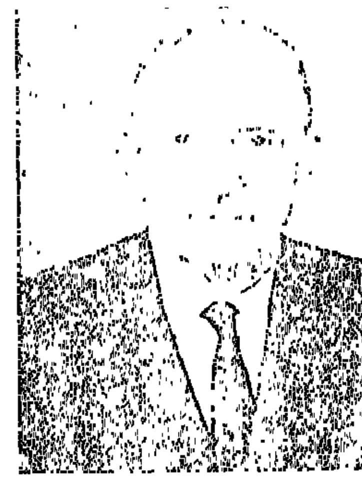
The studies will determine the number of men and women we will have in uniform, and something about what kinds of military situations we should be prepared to handle.

Determination of Force Structure

The second major problem faced by DOD is the determination of forces necessary to meet the national objectives.

This problem is not new, as many of you know. Secretary Forrestal had the problem back in 1948. He suggested a two-stage approach.

The first stage was to have the Joint Chiefs prepare their force



Honorable David Packard

structure plan—what they bel to be necessary to properly carry their military missions.

The second stage was to cycle t plan back through with budget constraints and achieve an agr upon plan for which an accept budget could be prepared. This w have been a logical approach— rational than just giving each Serv a budget limit and leaving the det for the Services to work out.

Apparently little progress was m toward achieving agreed upon f levels and force structures over next few years.

Mr. McNamara moved in wit new approach which seemed to h great hope. The plan in simple te was to select the forces for t various military missions by apply systems analysis and cost effective principles.

We believe that the point of dep ture in determining force struct must be the defense tasks defined the National Security Council. Th tasks then provide the basis for f development. In this development, are encouraging the Services to ap system analysis and cost effect procedures themselves. And we a encouraging our people in the Offic the Secretary of Defense to rea that all problems are not solved w analytical procedures alone.

We expect this approach to result in considerable progress toward a rational selection and evaluation of military force levels and weapon systems.

Let us take a few minutes to review where I believe we will be going in some of the important areas which affect you people here tonight.

As a first example, the multiple independent reentry vehicle (MIRV) program raises two issues. One is assuring reliability before production and deployment. The other has to do with arms limitation talks.

We believe we should look very closely at the probable need for a replacement for the B-52 fleet in the next few years. Work is now underway to define the program, and we expect to move ahead in an orderly way.

The Safeguard program, which I am confident Congress will approve, will be for the two sites at Malmstrom and Grand Forks. It will require nearly four years to build and install these two systems, and we have scheduled over a year of testing and system shake-down.

Further expansion or contraction of the system will depend on decisions in the future related to how the Russians and the Chinese move on their strategic forces.

The level and character of our tactical air program will continue to be in a period of uncertainty. The level will be influenced primarily by such decisions as the National Security Council makes on U.S. involvement, world-wide. The character will be determined by further discussions relating to land-based versus sea-based forces. It will be influenced by further discussions relating to air superiority, interdiction and close support. I do not expect all parties to come to a happy agreement on these matters, but I predict they will be influenced heavily by budgetary restraints.

There is no doubt that shipbuilding will be a major program over the next five years, but I do not consider that the level of attack carriers, anti-submarine warfare carriers, nor the related equipment is yet determined.

There are many other areas which will be under close scrutiny. As a result, I believe it is safe to say the whole military hardware field is likely to be fraught with more difficulty over the next few years.

Management of Development and Production

The third problem in the management of DOD is to procure and operate defense resources in the most efficient manner possible. This brings me to some observations about major weapon systems. I have reached the firm conclusion that we are designing and building weapons that are too complex and, therefore, too costly. We further compound the problem by trying to produce hardware before it is fully developed.

This means that we are going to take a very hard look at whether we need all this gadgetry when we go into a new development. A computerized fire control may increase the accuracy of tank gunnery, but so far it does not give evidence of increasing the reliability of gunnery. A tank with its gun out of order is no tank at all.

There will, of course, be cases where a complex device can be very important. There is considerable evidence that many—in fact, I can almost include most complex weapons—are put into production before they are fully developed. We probably cannot go to a "prototype for everything" route, but we can do a much better job in relating production and development.

What does this all mean in specific things that might be done? We do not, at this time, have plans worked out as to exactly how to attack these problems. There are some things I can say however.

We expect to have all future contracts for weapon systems include realistic achievement milestones which must be met before production is started. We need and will welcome your cooperation in developing workable procedures toward that end.

The Services will have to accept production schedules which are not tied to specific dates, but can expect rigid time schedules once production is authorized.

A related question is costing. I know you have been wrestling with this problem for some time, and I have only one thing to say on this subject now. You have to eliminate this business of buying in. Neither the Defense Department nor the Congress will continue to tolerate large cost overruns which relate to unrealistic pricing at the time of award, or to inadequate management of the job during the contract.

In simple terms, you will find it much more difficult for us to consider upward price revisions—and you should plan your affairs accordingly.

The Defense Department needs the help and support of the members of this audience. We will, as I have said, examine our requirements for new equipment more carefully. We are certain to have the continuing constraint of budgetary pressures on these requirements. We simply have to find ways to buy more defense for our taxpayer's dollar. We need your help. We need your help in building equipment with higher standards of reliability. We need your help in improving the development and production efficiency on military hardware. We need significant improvement in the accuracy of cost estimates, and in achieving better performance against cost targets. These are goals which are well within the capability of the aerospace industry. I hope you will agree with me that we should not and cannot settle for less.

Fleet Ships To Use New Fuel

The Navy is shifting to a new fuel to replace the Navy Special Fuel Oil (NSFO) for ship propulsion.

An all-distillate marine diesel type of fuel will take the place of NSFO on a time-phased basis, allowing the industry to adjust to the new requirements. The Navy could start using the new fuel as early as March 1970, reaching a peak of an estimated 46 million barrels a year by February 1972.

Although the new fuel will cost about $48 million more per year, operating costs will be reduced due to decreased maintenance. Total savings are expected to be millions of dollars per year when the new fuel is fully in use.

The use of the all-distillate fuel will greatly reduce shipboard boiler repairs and maintenance, resulting in improved ship readiness.

Before the Fleet can use the new fuel, however, shipboard fuel pumps and related equipment will have to be modified or replaced to handle the lower density of the fuel.

The interim specification for the new fuel, MIL–F24374 (Ships), is available from Navy Publication and Forms Center, NPSC–103, 5801 Tabor Ave., Philadelphia, Pa. 19120.

Secretary of Defense Laird Urges Continued Cost Reduction Effort

[Editor's note: The following letter dated May 16, 1969, forwarded by Secretary of Defense Melvin R. Laird to the active participants in the Defense Contractor Cost Reduction Program, is reprinted in the Bulletin *as a matter of interest to our readers.]*

"In my seventeen years of Defense service here in Washington, there has never been a period when the socio-economic need of our Nation focused such critical attention on Defense expenditures. That attention is deserved, for no department of our Government faces a more impressive management challenge.

"These times impose a special responsibility on everyone entrusted with the disposition of Defense funds —Government employees and Defense contractors alike. It is an unusual responsibility because the dimensions of the job to be done demand more from our talents than reasonable prudence and average success.

"We are continuously being asked to manage better. We are being asked to speed up innovation— to take new, major steps in our quest for more efficient, less costly ways to keep our defenses unassailable.

"This Department is moving quickly to meet the test. Since January, we have—

- established a Joint Logistic Review Board, consisting of high-ranking military officials, to review world-wide logistics support to combat forces during the Vietnam era, to identify strengths and weaknesses and make appropriate recommendations for improvement.
- instituted a Logistics Performance Measurement and Evaluation System for setting goals, measuring progress, and analyzing results in key logistics programs, functions and activities.
- applied new emphasis to our in-house Cost Reduction Program, from which we should realize over $1 billion in audited in-house savings this current fiscal year.
- set the groundwork for convening a Blue Ribbon Panel to review our entire Defense Department activities.

"Actions like these will bring us part way toward President Nixon's objectives of making "the most effective use . . . of all the country's resources in achieving the Nation's goals" and accomplishing "Governmental functions . . . with the least possible waste." I say "part way" because Defense cannot go it alone. We must rely heavily on industry's integrity and ingenuity to help us meet these objectives.

"I know that your firm—as one of the participants in the Defense Contractor Cost Reduction Program—appreciates the gravity of this responsibility and the immensity of the challenge. I am informed that you and your fellow contributors to this Program—through better manufacturing processes, value engineering, closer pricing of subcontracts, and other techniques of progressive management—have recorded cost benefits to Defense exceeding half-a-billion dollars in the 1st Half of FY 1969. To me, that kind of visible achievement speaks louder than repeated assurances of shared concern.

"It is my sincere belief that this Department and industry—working together—can give our Government the best value it has ever received in the Defense materiel and equipment it needs and can strengthen our procurement practices far beyond the norm of adequacy.

"I believe these are realistic expectations—and I know that I can count on your firm and on you personally to do your best to meet them. Further, I would welcome any proposals for improvement that you might have."

/signed/ Melvin R. Laird

Army Investigating Liquid Natural Gas as Turbine Fuel

The use of liquified natural gas as a replacement for general purpose (JP) fuel for helicopter gas turbines is being considered by the U.S. Army. The Army's Combat Developments Command (CDC), Fort Belvoir, Va., is seeking a cryogenic fuel in an effort to increase aircraft performance, safety and maintenance standards.

The CDC's Combat Service Support Group, Fort Lee, Va., has been looking at methane as the possible replacement. Tests have shown that methane permits higher internal combustion temperatures with resulting higher horsepower outputs. At 3,000 degrees F. methane yields 305 horsepower per pound of fuel per second, while JP fuel is temperature limited to 2,200 degrees and 200 horsepower. Even higher combustion temperatures are possible with methane, with resulting increased horsepower ratings.

To counteract the increased temperatures, methane's cryogenic properties would allow it to be channeled through the aircraft to cool working parts. Used to cool the turbines exhaust, this would, in turn, decrease the aircraft's infrared "signature."

CDC sees other advantages to such cryogenic fuels. Methane's low vaporization temperature would eliminate fuel-drenched accident scenes. It is non-toxic, inexpensive and as plentiful as petroleum. A "clean" fuel, methane produces little carbon and sulpher to clog engine parts and pollute the air.

Present shipping and storing facilities for JP fuel would have to be changed for methane, and a double-walled, lightweight fuel tank for aircraft would be required before any changeover.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Dennis James Doolin has been sworn in as Dep. Asst. Secretary of Defense (International Security Affairs) for East Asia and Pacific Affairs. He succeeds **Richard A. Steadman**, who has entered private business.

Dr. Roland F. Herbst, formerly of the University of California's Lawrence Radiation Laboratory, is now Dep. Dir. (Strategic and Space Systems), Office of Dir. of Defense Research and Engineering. He succeeds **Dr. Lloyd R. Wilson**, who has entered private business.

Brig. Gen. Arthur E. Exon, USAF, Commander, Defense Contract Administration Services Region, Los Angeles, Calif., has retired.

The Defense Contracts Administration Services District, Indianapolis, at Fort Benjamin Harrison, Ind., has a new Commander, **Col. Robert W. Allen, USA**.

Col. James B. Myers, USAF, has been named Chief, Special Projects Division, Defense Atomic Support Agency, Arlington, Va.

Col. John W. Oliver, USAF, is the new Chief, Satellite Communications Field Office, Defense Communications Agency, Fort Monmouth, N.J.

Cmdr. Calvin R. Anweiler, SC, USN, has been assigned as Commander, Twin Cities District, St. Paul, Minn., of the Defense Contract Administration Region, St. Louis, Mo.

DEPARTMENT OF THE ARMY

Thaddeus R. Beal has been sworn in as Under Secretary of the Army.

Maj. Gen. Robert E. Coffin has left his position as Dep. Chief of Research and Development. **Brig. Gen. Kenneth F. Dawalt**, former Dep. Chief Research and Development for International Programs, is acting Dep. Chief.

Maj Gen. William C. Gribble has assumed command of the Army Engineer Center and Fort Belvoir, Va.

Maj Gen. Lee B. Jones has been named Chief of Staff, Army Materiel Command, Washington, D.C.

The Army Corps of Engineers, Washington, D.C., has announced the following assignments: **Maj. Gen. Frederick J. Clarke**, Dep. Chief of Engineers, will become Chief of Engineers on August 1. **Maj. Gen. Carrol H. Dunn** will succeed Maj. Gen. Clarke as Dep. Chief. **Maj. Gen. Richard H. Free** will become Division Engineer, South Atlantic Division, Atlanta, Ga., and **Brig. Gen. Daniel A. Raymond** will become Dir. of Military Construction, Office of the Chief of Engineers on August 1. **Brig. Gen. William W. Watkin Jr.** is now Division Engineer, North Central Division, Chicago, Ill.

Col. Frank B. Case has been named Dir. of Plans, Military Traffic Management and Terminal Service, Bailey's Crossroads, Va.

Col. Richard A. Hiscox has been appointed Asst. Dir. of the Budget (Operations), Office of the Army Comptroller, replacing **Brig. Gen. Lewis E. Maness**.

The Army Munitions Command, Dover, N.J., has a new Dep. Commander, **Col. Peter G. Olenchuk**.

DEPARTMENT OF THE NAVY

RAdm. Lawrence G. Bernard is the new Dir., Shore Installations Division, Office of the Chief of Naval Operations, replacing **RAdm. Frederick E. Janney**. RAdm. Janney will become Dep. Chief of Staff, Military Assistance Logistics and Administration, Joint Staff of the Commander in Chief, Pacific.

RAdm. Ira F. Haddock, SC, has been named Commander, Naval Supply Center, Norfolk, Va.

RAdm. Howard S. Moore has been chosen as the new Commander, Pacific Missile Range, Point Mugu, Calif.

Capt. Kenneth W. Cramp will be the new Dir., Naval Electronics Systems Command, Western Division, at San Francisco Naval Shipyard, Vallejo, Calif.

Capt. Bernard W. Frese has been selected to relieve **Capt. Leslie R. Olsen** as Commander, Naval Ordnance Station, Indian Head, Md. Capt. Leslie is retiring.

Capt. Clarence T. Froscher has been named Commander, Naval Air Engineering Center, Philadelphia, Pa.

Capt. James L.F. Hennessy, SC, has been assigned as Dep. Commander/Chief of Staff, Western Area, Military Traffic Management and Terminal Service, Oakland, Calif.

The new West Coast Representative of the San Diego Technical Office, Deep Submergence Systems Project, is **Capt. Walter F. Mazzone**.

Capt. Blake W. Van Leer is the new Commander, Chesapeake Division, Naval Facilities Engineering Command, Washington, D.C.

DEPARTMENT OF THE AIR FORCE

Spencer J. Schedler has been nominated as the replacement for **Thomas H. Neilson** as Asst. Secretary of the Air Force (Financial Management).

Brig. Gen. Richard M. Hoban has been named Vice Commander, San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex.

The Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif., has a new Vice Commander, **Brig. Gen. Edwin L. Little**.

Brig. Gen. Gustav E. Lundquist, Commander, Arnold Engineering Development Center, (AFSC), Arnold AFS, Tenn., will retire at the end of July.

Col. Brian S. Gunderson, (brig. gen. selectee), has been assigned Chief of Staff, U.S. Air Force in Europe.

Col. Charles C. Pattillo, (brig. gen. selectee), has been named Vice Commander, Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla.

The Air Force Systems Command has chosen **Col. Milton R. Buls** as Dir., Foreign Technology, Aeronautical Systems Division, Wright-Patterson AFB, Ohio.

Col. Lawrence A. Fowler will become Dir., Procurement and Production, Manned Orbiting Laboratory, Space and Missile Systems Organization, (AFSC), Los Angeles, Calif.

Col. Ralph A. Johnson has been named to succeed **Brig. Gen. James A. Bailey** as Vice Commander, Warner

Robins Air Materiel Area, (AFLC), Robins AFB, Ga.

Col. Rio G. Lucas is the new Asst. for Engineering/Construction, Office of the Asst. Secretary of the Air Force (Installation and Logistics).

Air Force Systems Command has named Col. Ernest F. Moore as its Dir. Civil Engineering, Arnold Engineering Development Center, Arnold AFS, Tenn.

Col. Clifford E. Smith has been assigned as Chief, Requirements Div., Air Force Systems Command headquarters, Andrews AFB, Md.

Col. Elbert M. Stringer is the new Dir., C-141/C-130 Systems Program Office, Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. He will also manage the B-57G and C-9 programs.

Integrated Logistics

(Continued from page 33)

Today, and for the future, as General Hamilton was so keenly aware, it is an absolute necessity that there be an understanding of the requirements for combat and the requirements for support. Further, it is necessary that the requirements for both be balanced and comprehended for it is at the end of the line, at the sharp point of the bayonet, where the warfare and support concepts focus. Because our weapons, technology and methodology are today so terribly complex, they demand the application of engineering principles to shape the total logistic system and configure it to satisfy its ultimate objective—WARFARE.

Army Closing Five Nike Hercules Sites

The Department of the Army has announced the closing of five Nike Hercules firing sites in four states in the continental United States. It is expected that the closing will save the Army $3.6 million in FY 1970 and in each succeeding year.

The sites to be closed are Milwaukee, Wis., Detroit and Carlton, Mich., Warrington, Pa., and Felicity, Ohio. The sites at Milwaukee and Detroit are manned by active Army units. All units will be converted to other unit types.

Military Activities Realigned To Meet Budget Cuts

Secretary of Defense Melvin R. Laird has announced changes aimed at budget reductions affecting 36 military installations and activities in the United States. Among the most significant planned are the realignment of the North American Air Defense Command (NORAD), reorientation of the Army and Navy's research and development establishments, and the consolidation of three Defense Supply Agency's (DSA) Subsistence Regional Headquarters.

The realignment of NORAD's ground environment and command control structure is intended to modernize the air defense system. Key changes in the realignment include phasing out of the 4th Air Force Aerospace Defense Command and its combat center, Hamilton AFB, Calif., and the 36th NORAD Division Headquarters and Direction Center, Adair AFS, Oregon.

In addition, one aircraft control and warning station, five defense early warning stations and six radar squadrons will be closed by September 1969 and two additional aircraft control and warning stations and two radar stations will be closed by December 1969. Three of the sites will be taken over by the Federal Aviation Agency.

The Army and Navy research and development reorientation will affect the Army's Frankford Arsenal, Philadelphia, Pa., which will be relocated. The limited production capacity of the arsenal will be retained. Three Naval laboratories will be affected, including the Naval Weapons Center Corona Laboratories, Corona, Calif., which will be consolidated with the Naval Weapons Center, China Lake, Calif., with the exception of the Fleet Missile Systems Analysis and Evaluation Group which will remain at the Corona facility. The Naval Radiological Defense Laboratory, San Francisco, Calif., will be disestablished and functions will be transferred to other Naval facilities. The activities of the Naval Applied Science Laboratory, Brooklyn, N.Y., will be reduced to only the current navigational efforts by June 1970.

DSA Subsistence Regional Headquarters changes include consolidation of the Seattle, Wash., and Los Angeles, Calif., headquarters with the Alameda, Calif., facility, and consolidation of the Kansas City headquarters with those in New Orleans, La., and Chicago, Ill.

Army Terminates Cheyenne Production

The Department of the Army has terminated the production phase of the AH-56A Cheyenne armed helicopter program. The reason given was for default of the contractor, Lockheed Aircraft Corp.

Simultaneously it was announced that Lockheed may be issued a "cure notice" on the research and development contract for the Cheyenne, notifying the company of deficiencies. Army officials are hopeful, however, that a satisfactory program to permit continuation of development can be devised.

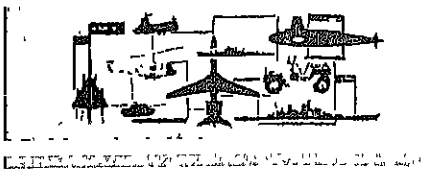
The termination affected only the production phase of the Cheyenne program.

DFSC To Use New Type Contracting for Buying Coal

The Defense Fuel Supply Center is planning to change the types of contracts it uses for purchasing coal for military installations. The change will be from the current firm quantity contracts to requirement contracts, which are used where required quantities cannot be accurately forecast.

The new contracts will include an estimated yearly total quantity needed by an installation, but will also give a maximum tonnage the supplier may be called on to furnish. Greater flexibility is expected by allowing each installation's ordering officer to contact the contractor for delivery schedules, benefiting the supplier through more accurate planning. Large quantity deliveries could be planned to take advantage of possible volume freight rates, with resulting lower costs.

The center, a field activity of the Defense Supply Agency, located in Alexandria, Va., annually buys $22 million worth of coal. The changeover will be made on a phased basis. No other change will be made in current purchasing methods or in contracts for civil agency installations.



DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of May, 1969.

DEFENSE SUPPLY AGENCY

1—Sinclair Oil Corp., New York, N.Y. $1,-978,117. Various quantities of fuel oil and gasoline. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1678.

2—Aluminum Company of America, Pittsburgh, Pa. $12,853,984. 40,806,300 pounds of aluminum powder. Defense General Supply Center, Richmond, Va. DSA 400-69-C-5534.

—Sinclair Oil Co., New York, N.Y. $2,707-777. Various quantities of fuel oil and gasoline. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1506.

—Gulf Oil Corp., Houston, Tex. $2,547,229. Various quantities of fuel oil and gasoline. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1492.

—Alcan Metal Powders, Inc., Elizabeth, N.J. $1,141,312. 3,566,000 pounds of aluminum powder. Defense General Supply Center, Richmond, Va. DSA 400-69-C-5538.

6—General Foods Corp., White Plains, N.Y. $2,029,268. 3,520,000 two-pound containers of instant rice. Dover, Del. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-69-C-M126.

9—Gulf Oil Corp., New York, N.Y. $2,692,800. 30,000,000 gallons of JP-4 jet fuel. Puerto Rico. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1830.

12—Gulf Oil Corp., Houston, Tex. $3,781,690. 10,700 gallons premium gasoline, 3,683,-010 gallons regular gasoline, 4,466,100 gallons diesel fuel, 212,100 gallons kerosene and 25,153,100 gallons fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1248.

14—Mobile Oil Corp., New York N.Y. $1,337,-500. 250,000 barrels of Grade DF-A diesel fuel for the Army. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-0570 POOI.

—Cherubinco Petti and Co., Inc., Atlantic City, N.J. $1,408,500. 75,000 men's wool serge coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2319.

15—Towmotor Corp., Cleveland, Ohio. $1,391,-175 229 gasoline-powered forklift trucks. Defense General Supply Center, Richmond, Va. DSA 400-69-C-5747.

—Alpha Industries, Inc., Knoxville, Tenn. $1,379,000. 250,000 men's cotton-nylon coats with hoods. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2317.

16—Pettibone Mulliken Corp., Washington, D.C. $1,755,988. 226 electric forklift trucks. Defense General Supply Center, Richmond, Va. DSA 400-69-C-6073.

—Damascus Hosiery Mills, Inc., Damascus, Va. $1,172,299. 2,000,000 pairs of men's socks. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2427.

19—Putnam Mills Corp., New York, N.Y. $2,-844,940. 8,673,000 yards of wind resistant poplin. Marion, N.C., Whitmore, S.C., Great Falls, S.C., and Columbus, Ga. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2425.

—American Oil Co., Chicago, Ill. $2,704,576. Fuel oil and gasoline. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1510.

—Burlington Industries, Inc., New York, N.Y. $2,302,200. 3,00,000 yards of wind resistant poplin. Mooresville, N.C., Cheraw, S.C., and Cramerton, N.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2426.

—Valley Metallurgical Processing Co., Essex, Conn. $2,111,740. 3,105,500 pounds of magnesium powder. Stockton, Calif. Defense General Supply Center, Richmond, Va DSA 400-69-C-5728.

—Hart Metals, Inc., Tamaqua, Pa. $1,159,-396. 1,698,750 pounds of magnesium powder. Defense General Supply Center, Richmond, Va. DSA 400-69-C-5729.

20—American Oil Co., Chicago, Ill. $1,765,248. Various quantities of fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1447.

22—Gibralter Fabrics, Inc., Brooklyn, N.Y. $1,015,243. 166,350 liners for men's field coats. Brooklyn, and Bridgeton, N.J. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2489.

23—Bibb Manufacturing Co., Macon, Ga. $3,-498,550. 760,780 linear yards of 45-inch wide nylon twill cloth. Salisbury, N.C., Macon, Columbus and Percale, Ga. Defense Personnel Support Center. Philadelphia, Pa. DSA 100-69-C-2500.

—Phipps Products Corp., Boston, Mass. $1,-675,007. Petrochemicals. Defense Fuel Supply Center, Alexandria, Va. DSA 640-69-D-2151.

27—J.P. Stevens and Co., Inc., New York, N.Y. $4,727,406. 1,286,168 yards of wool serge cloth. Greer and Wallace, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2507.

28—The Defense Fuel Supply Center, Alexandria, Va., has awarded the following 53 contracts for JP-4 and JP-5 fuel:

Fletcher Oil & Refining Co., Carson, Calif. $1,607,286. 12,500,000 gallons. DSA 600-69-D-1972.

Golden Eagle Refining Co., Inc., Los Angeles, Calif. $5,189,854. 89,000,000 gallons. DSA 600-69-D-1978.

Humble Oil & Refining Co., Houston, Tex. $12,717,187. 116,472,000 gallons. DSA 600-69-D-1975.

Kern County Refinery, Inc., Los Angeles, Calif. $1,205,069. 8,830,000 gallons. DSA 600-69-D-1979.

Mobil Oil Corp., New York, N.Y. $16,-001,712. 152,002,250 gallons. DSA 600-69-D-1981.

Powerline Oil Co., Santa Fe Springs, Calif. $3,161,408. 25,000,000 gallons. DSA 600-69-D-1983.

Shell Oil Co., New York, N.Y. $8,898,-800. 88,000,000 gallons. DSA 600-69-D-1984.

U.S. Oil & Refining Co., Tacoma, Wash. $1,198,061. 9,056,250 gallons. DSA 600-69-D-1986.

American Oil Co., Chicago, Ill. $8,552,-559. 81,527,780 gallons. DSA 600-69-D-1993.

Adobe Refining Co., La Blanca, Tex. $1,781,920. 15,000,000 gallons. DSA 600-69-D-1991.

Alabama Refining Co., Inc., Theodore, Ala. $7,392,500. 70,000,000 gallons. DSA 600-69-D-1992.

American Petrofina Co. of Texas, Dallas Tex. $3,642,037. 34,975,000 gallons. DSA 600-69-D-1994.

Bell Oil & Gas Co., Bartlesville, Okla. $4,505,060. 44,849,000 gallons DSA 600-69-D-2001.

Cardinal Transports, Inc., San Antonio, Tex. $1,267,800. 12,000,000 gallons. DSA 600-69-D-2003.

Cities Service Oil Co., New York, N.Y. $1,133,285. 11,340,000 gallons. DSA 600-69-D-2006.

Coastal States Petrochemical Co., Houston, Tex. $19,017,842. 182,516,000 gallons. DSA 600-69-D-2007.

Continental Oil Co., Houston, Tex. $11,-152,588. 108,628,000 gallons. DSA 600-69-D-2009.

Crystal Flash Petroleum Corp., Indianapolis, Ind. $1,467,675. 12,510,000 gallons. DSA 600-69-D-2010.

Delta Refining Co., Memphis, Tenn. $4,-435,816. 41,900,000 gallons. DSA 600-69-D-2011.

Diamond Shamrock Corp., Amarillo, Tex. 3,555,090. 32,062,000 gallons. DSA 600-69-D-2012.

Edgington Oil Co., Long Beach, Calif. $2,569 036. 20,500,000 gallons. DSA 600-69-D-2014.

Famariss Oil & Refining Co., Hobbs, N.M. $1,160,719. 9,000,000 gallons. DSA 600-69-D-2016.

Atlantic Richfield Co., Philadelphia, Pa. $10,641,750. 105,000,000 gallons. DSA 600-69-D-1998.

Fletcher Oil & Refining Co., Carson, Calif. $2,633,500. 21,000,000 gallons DSA 600-69-D-2017.

Fort Worth Refining Co., Houston, Tex. $5,008,603. 45,000,000 gallons. DSA 600-69-D-2018.

Getty Oil Co., New York, N.Y. $6,449,-740. 60,278,000 gallons. DSA 600-69-D-2019.

Golden Eagle Refining Co., Los Angeles, Calif. $6,078,135. 48,300,000 gallons. DSA 600-69-D-2021.

Good Hope Refineries, Inc., Houston, Tex. $4,678,200. 46,000,000 gallons. DSA 600-69-D-2022.

Hess Oil & Chemical Corp., Woodbridge, N.J. $4,430,610. 45,360,000 gallons. DSA 600-69-D-2025.

Humble Oil & Refining Co., Houston, Tex. $38,445,535. 378,000,000 gallons. DSA 600-69-D-2026.

Howell Refining Co., San Antonio, Tex. $3,170,317. 27,500,000 gallons. DSA 600-69-D-2027.

Hunt Oil Co., Dallas, Tex. $1,008,900. 11,000,000 gallons. DSA 600-69-D-2028.

Kern County Refinery, Inc., Los Angeles, Calif. $2,120,175. 16,320,000 gallons. DSA 600-69-D-2032.

Macmillan Ring-Free Oil Co., Los Angeles, Calif. $4,026,680. 32,908,500 gallons. DSA 600-69-D-2038.

Mobil Oil Corp., New York, N.Y. $20,-557,255. 183,800,000 gallons. DSA 600-69-D-2039.

Monarch Refining Co., San Antonio, Tex. $1,066,028. 9,000,000 gallons. DSA 600-69-D-2040.

Okmulgee Refining Co., Inc., Okmulgee, Okla. $1,794,753. 18,140,000 gallons. DSA 600-69-D-2042.

Phillips Petroleum Co., Bartlesville, Okla. $9,801,264. 84,080,000 gallons. DSA 699-69-D-2045.

Pride Refining Inc., Abilene, Tex. $2,-084,508. 18,000,000 gallons. DSA 600-69-D-2046.

Signal Oil & Gas Co., Houston, Tex. $1,-137,950. 11,000,000 gallons. DSA 600-69-D-2048.

Southwestern Oil & Refining Co., Corpus Christi, Tex. $6,806,300. 63,000,000 gallons. DSA 600-69-D-2050.

Southwestern Pallet Co., Abilene, Tex. $1,185,129. 10,132,000 gallons. DSA 600-69-D-2051.

Shell Oil Co., New York, N.Y. $1,510,-880. 15,200,000 gallons. DSA 600-69-D-2052.

Sun Oil Co., Philadelphia, Pa. $8,074,-500. 74,400,000 gallons. DSA 600-69-D-2054.

Suntide Refining Co., Tulsa, Okla. $2,-978,700. 30,000,000 gallons. DSA 600-69-D-2055.

Sun Oil Co., Tulsa, Okla. $2,802,300. 30,000,000 gallons. DSA 600-69-D-2056.

Tesoro Petroleum Corp., San Antonio, Tex. $5,038,670. 41,000,000 gallons. DSA 600-69-D-2057.

Tonkawa Refining Co., Houston, Tex. $2,146,004. 20,000,000 gallons. DSA 600-69-D-2059.

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company — Value — Material or Work to be Performed—Location of Work Performed (if other than company plant) — Contracting Agency—Contract Number.

Triangle Refineries, Inc., Houston, Tex. $2,478,000. 21,600,000 gallons DSA 600-69-D-2060.

Union Oil Co., Los Angeles, Calif. $4,-856,374. 85,240,000 gallons. DSA 600-69-D-2061.

Southland Oil Co, Yazoo City, Miss $1,160,654. 10,500,000 gallons. DSA 600-69-D-2049

Ashland Oil & Refining Co., Ashland, Ky. $5,981,687. 56,440,000 gallons. DSA 600-69-D-1997.

Bayou Refining Co., Inc., Pasadena, Tex $8,909,225. 87,050,000 gallons. DSA 600-69-D-1999.

—**Servicemaster Industrial Systems Co.**, Downersgrove, Ill. $1,183,334. 143,460 coated nylon twill, wet weather parkas. Cairo, Ill. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2560.

—**J. P. Stevens & Co., Inc.**, New York, N.Y. $8,550,000. 984,000 linear yards of wool serge cloth. Green and Wallace, S.C. Defense Jersonnel Support Center, Philadelphia, Pa. DSA 100-69-C-2508.

—**Brownwood Mfg. Co.**, Dallas, Tex. $1,159,-269. 448,200 pairs of men's wind resistant, cotton poplin trousers. Early and Brownwood, Tex. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2538.

20—**Burlington, Industries, Inc.**, New York, N.Y. $8,298,677. 1,679,296 yards of polyester and wool tropical cloth. Raeford, N.C., Halifax and Clarksville, Va. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2585.

—**J. P. Stevens & Co., Inc.**, New York, N Y. $1,502,424. 1,104,000 yards of oxford cloth. Whitmire, S.C., and Westerly, R.I. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2561.

—**Hess Oil & Chemical Corp.**, Woodbridge, N.J. $2,890,220. 26,050,000 gallons of JP-5 jet fuel. Port Reading, N.J. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1978.

—**Delta Petroleum Co., Inc.**, New Orleans, La. $1,316,169. 2,668,661 gallons of lubricating oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-2106.

—**Sun Oil Co.**, Philadelphia, Pa. $1,116,887. 9,069,000 gallons JP-5 jet fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1985.

DEPARTMENT OF THE ARMY

1—**Jervis B. Webb Co., of Calif.**, Washington, D.C. $1,822,663. Furnish and install a material handling system at Tooele Army Depot to automate receiving and shipment of general supplies. Detroit, Mich., and South Gate, Calif. San Francisco Procurement Agency, Oakland, Calif. DA-AG05 69 C-0727.

—**KDI Precision Products, Inc.**, Cincinnati, Ohio. $1,139,040 (contract modification). 2.75-inch rocket fuze safety and arming devices. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0593.

—**Acushnet Co.**, New Bedford, Mass. $1,008,-934. Navy gas masks. Edgewood Arsenal, Md. DA-AA15-69-C-0503.

2—**American Machine and Foundry Co.**, New York, N.Y. $4,056,000 (contract modification). Metal parts for 750-pound general purpose bombs. Garden City, N.Y. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0035.

—**Jackes Evans Manufacturing Co.**, St. Louis, Mo. $2,608,000. M13 links for 7.62 mm cartridges. Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C 0522.

—**Sperry Rand Corp.**, Washington, D.C. $2,-500,000. Classified electronic equipment. St. Paul, Minn. Army Electronics Command, Fort Monmouth, N.J.

—**Union Carbide Corp.**, New York, N.Y. $1,990,710 (contract modification). Power supplies for M514 fuzes for artillery projectiles. Bennington, Vt. Harry Diamond Laboratory, Washington, D.C. DA-AG39-69-C-0073.

—**AVCO Corp.**, Stratford, Conn. $1,506,130 Turbine nozzles for T53 gas turbine engines for UH-1 helicopters Army Aviation Materiel Command, St. Louis, Mo. AF-41-608-69-A-2421.

—**AVCO Corp.**, Stratford, Conn $1,277,500. Fuel controls and inlet guide units for T54 turbine engines for CH-47 helicopters Army Aviation Materiel Command, St Louis, Mo. AF-41-608-69-A-2421

5—**General Electric Co.**, Bethesda, Md. $1,-338,673 Purchase of previously installed and rented GE 635 computer system at Griffiss AFB, N.Y. Army Electronics Command, Philadelphia, Pa. GS-OOOS-76171.

—**Sylvania Electronic Systems**, Mountain View, Calif 1,105,200. Telephone analyzer sets. Mountain View, Calif., and Santa Cruz, Calif. San Francisco Procurement Agency, Oakland, Calif. DA-AB05-69-C-0712

6—**M. Morrin & Sons Co., Inc.**, Odgen, Utah $1,219,900. Construction of an ammunition maintenance facility at Tooele Army Depot, Tooele, Utah. Army Engineer District, Sacramento, Calif. DA-CA05-69-C-0095.

—**Hallicrafters Co.**, Rolling Meadows, Ill $1,000,000. AN/ALQ80 radar jammers and test fixtures. Army Electronics Command, Fort Monmouth, N J. DA-AB07-69-C-00100.

7—**Bell Aerospace Corp.**, Fort Worth, Tex. $1,993,700. Rotor modification kits for AH-1 helicopters. Hurst, Tex. Army Aviation Systems Command, St Louis, Mo. DA-AJ01-69-A-0314.

—**Olin Mathieson Chemical Corp.**, East Alton, Ill. $1,050,873. .45 caliber cartridges. Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C-0537.

8—**Standard Container Co.**, Montclair, N.J. $4,515,000. Metal ammunition boxes. Homerville, Ga. Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C-0185

9—**R.G. LeTourneau, Inc.**, Long View, Tex. $5,980,800 (contract modification). Metal parts for 750-pound bombs. Longview, Lone Star, Tex., and other locations. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0044.

—**Flinchbaugh Products, Inc.**, Red Lion, Pa. $2,393,373. Warheads, insulation assemblies and motor body bonding assemblies for 105mm projectiles. Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0619.

—**Bell Aerospace Corp.**, Fort Worth, Tex. $6,604,874. Rotary wings blades for UH-1 helicopter. $1,867,780. UH-1 hanger assemblies. $1,338,430. UH-1 tail rotor hubs Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

12—**MacGregor-Triangle Co.**, Boise, Idaho. $3,-569,651. Relocation of 8.7 miles of road at Libby Dam Project, Mont. Army Engineer District, Seattle, Wash. DA-CW67-69-C-0037.

—**Martin K. Eby Construction Co., Inc.**, Wichita, Kan. $1,226,944 Construction of enlisted men's barracks and medical facility, Fort Leonard Wood, Mo. Army Engineer District, Kansas City, Mo. DA-CA41-69-C-0064.

—**Chrysler Motors Corp.**, Warren, Mich. $1,-202,949. Transmissions, differentials and rear axles for ¼-ton trucks (M37). Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-3447.

13—**Whittaker Corp.**, Westerville, Ohio. $1,-157,884. Metal parts for 105mm projectiles (M489). Columbus, Ohio. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0410.

—**Kaiser Aerospace and Electronics Corp.**, Glendale, Calif. 1,032,150. Long lead time items for fabrication, test and assembly of detection devices. Harry Diamond Laboratories, Washington, D.C. DA-AG39-69-C-0049.

—**Kanaar Corp.**, Kingston, Pa. $2,445,885. Shoulder-operated 40mm grenade launchers. Army Weapons Command, Rock Island, Ill. DA-AF03-69-C-0084.

—**Gentex Corp.**, Carbondale, Pa. $1,575,000. 21,000 SPH-4 air crewmen protective helmets. Army Procurement Agency, New York, N.Y. DA-AG25-69-C-0881.

14—**Telex-Midwestern Division**, Tulsa, Okla. $1,500,000. Classified electronic equipment. Army Electronics Command, Fort Monmouth, N.J.

15—**General Motors Corp.**, Cleveland, Ohio. $1,191,494. Engineering design and testing of the XM-70 tank. Army Tank Automotive Command, Warren, Mich. DA-20-113-AMC-08843(T).

16—**King-Hunter, Inc.**, Greensboro, N.C. $1,-654,227. Construction of a two-story addition to a building at Tarheel Army Missile Plant, Burlington, N C Army Engineer District, Savannah, Ga. DA-CA21-69-C-0113.

—**Union Carbide Corp.**, New York, N.Y $1,193,215. BA270/U dry batteries for AN/PRC-6 radio sets Charlotte, N.C. Procurement Division, Army Electronics Command, Philadelphia, Pa. DA-AB05-69-C-3629.

—**Chaney and Hope, Inc.**, Addison, Tex $2,-619,582. Construction of firing ranges, numerous buildings and roads at Fort Carson, Colo Army Engineer District, Omaha, Neb. DA-CA45-69-C 0080.

—**Stevens Manufacturing Co.**, Ebensburg, Pa. $1,690,861 Semi-trailer vans (M313) and semi-trailer chassis (M295A) Army Tank Automotive Command, Warren, Mich DA-AE07-69-C-1894

—**Hoffman Electronics Corp.**, El Monte, Calif $1,788,000. Design and engineering development models of AN/TRN radio beacon and ancillary items Army Electronics Command, Fort Monmouth, N J. DA-AB07-69-C-0320.

—**Martin Marietta Corp.**, Orlando, Fla. $17,-737,500. Ground support equipment for Pershing missiles for the Federal Republic of Germany. Orlando and Paoli, Pa. Army Missile Command, Huntsville, Ala. DA-AH01-69-C-1534.

—**Dondlinger and Sons Construction Co., Inc.**, Wichita, Kan. $1,092,000 Construction of two 3-story airmen dormitories at McConnell AFB, Wichita, Ka. Army Engineer District, Kansas City, Mo. DA-CA41-69-C-0065.

—**General Motors Corp.**, Indianapolis, Ind. $1,100,000. Evaluation, redesign, fabrication and test of the automatic loader for the XM70 combat tank Army Tank Automotive Command, Warren, Mich. DA-20-113 AMC-08843(T)

19—**Texas Instruments, Inc.**, Dallas, Tex $2,-305,983 (contract modification). AN/ASQ-127 night vision surveillance systems Army Mobility Equipment Research and Development Center, Fort Belvoir, Va DA-AK02 68-C-0308

—**Olin Mathieson Chemical Corp.**, La Porte, Ind. $1,793,550. Load, assemble and pack 20mm cartridges. Frankford Arsenal, Philadelphia, Pa. DA-AA22-69-C-0227.

—**Bell Aerospace Corp.**, Fort Worth, Tex. $1,168,115. Hydraulic servo cylinders for OH-58A helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-A-0118.

—**Hayes-Albion Corp.**, Albion, Mich. $1,036,-160. Metal parts for 81mm projectiles. Albion and Hillsdale, Mich. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0309.

20—**Melpar**, Falls Church, Va. $5,790,031. High frequency ground radio systems for Iran Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C 0289.

—**Bell Aerospace Corp.**, Fort Worth, Tex. $3,549,000. Modification kits for UH-1 helicopters Hurst, Tex. Army Aviation Materiel Command, St. Louis, Mo. DA-AJ01-69-A-0314.

—**Pace Corp.**, Memphis, Tenn. $1,826,754 (contract modification). M127A1 illumination signals. Memphis and Camden, Ark Picatinny Arsenal, Dover, N.J. DA-AA21-69 C-0619.

—**Hercules Engines, Inc.**, Canton, Ohio $1,550,468. Multi-fuel engine assemblies for 5-ton trucks. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4394

—**ITT Gilfillan, Inc.**, Van Nuys, Calif. $1,-400,000. AN/TPN-18 radar sets and ancillary items. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0288

—**General Motors Corp.**, Indianapolis, Ind $1,115,301. T-63 engines for light observation helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-C-1338.

—**Thiokol Chemical Corp.**, Bristol, Pa. $3,-215,156. Load, assemble and pack medium and large caliber ammunition. Marshall, Tex. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00200(A).

—**Harvey Aluminum Co.**, Torrence, Calif. $3,004,954. Load, assemble and pack medium caliber ammunition, Milan, Tenn Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00520(A).

—**National Gypsum Co.**, Buffalo, N.Y. $2,-676,545. Load, assemble and pack medium

and large caliber ammunition. Parsons, Kan. Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-11-173-AMC-00095(A).

—Sperry Rand Corp., New York, N.Y. $2,105,794. Load, assemble and pack large caliber ammunition. Shreveport, La. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00080(A).

21—Caterpillar Tractor Co., Peoria, Ill. $5,647,439 (contract modification). Tractors, repair parts and service manuals. Peoria and Aurora, Ill. Army Mobility Equipment Command, St. Louis, Mo DA-AK01-68-C-8147.

—R.A. Heintz Construction Co., Portland, Ore. $3,997,008. Relocation of 10 4 miles of state highway near Eureka, Mont. Army Engineer District, Seattle, Wash. DA-CW67-69-C-0039.

—Bauer Dredging Co., Inc., Port Lavaca, Tex. $1,172,648. Dredging of shoal material in the Houston ship channel Army Engineer District, Galveston, Tex. DA-CW64-69-C-0075.

—Non-Profit Institution of Cornell University, Ithaca, N.Y. $7,317,900 (contract modification). Continuation of research in the Interdisciplinary Materials Research Program. Defense Supply Service, Washington, D.C. DA-HC15-67-C-0214.

—Non-Profit Institution of the University of Pennsylvania, Philadelphia, Pa $6,894,300 (contract modification). Research in the Interdisciplinary Materials Research Program. Defense Supply Service, Washington, D.C. DA-HC15-67-C-0215.

—Non-Profit Institution of the University of Illinois, Urbana, Ill. $6,234,400 (contract modification). Research in the Interdisciplinary Materials Research Program. Defense Supply Service, Washington, DC. DA-HC15-67-C-0221.

22—Atlas Corp. and H.C. Smith Construction Co., DBA Global Associates, Oakland Calif. $60,195,595. Logistic support for Kwajalein Missile Range, Marshall Islands. Safeguard System Command, Huntsville, Ala. DA-HC60-70-C-0001.

—Bell Aerospace Corp., Fort Worth, Tex. $1,921,045. Main rotor blades for UH-1 helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo DA-AJ01-69-A-0314.

—White Motor Corp., Lansing, Mich. $1,313,749. 2½-ton truck gasoline engines with accessories. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-3443.

—General Electric Co., Burlington, Vt. $1,068,346 (contract modification). Various quantities of line item spare parts for Vulcan XM163 and XM167 weapons systems. Army Procurement Agency, New York, N.Y. DA-AG25-69-C-0403

23—J.J. Altman and Co., East St. Louis, Ill. $7,667,865. Construction of headquarters building #4 at the Military Airlift Command, Scott AFB, Belleville, Ill. Army Engineer District, Chicago, Ill. DA-CA23-69-C-0091.

—TRW Inc., Redondo Beach, Calif. $3,000,000. Classified electronics equipment. Army Electronics Command, Fort Monmouth, N.J.

—Bell Aerospace Corp., Fort Worth, Tex. $2,531,108. Main rotor blades for UH-1 helicopters. Hurst, Tex. Army Aviation Systems, St. Louis, Mo. DA-AJ01-69-A-0314.

—Texas Instruments, Inc., Dallas, Tex. $1,735,000. Classified equipment. Dallas and Sherman, Tex. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. DA-AK02-69-C-0603.

—Sheldow Bronze Corp., Kingwood, W. Va. $1,376,820. Bronze grave markers for veteran's graves. Office of the Chief of Support Services, Washington, D.C. DA-49-056-SS-(70)-391.

—Texas Instruments, Inc., Dallas, Tex. $1,214,010. Classified work. Dallas and Sherman, Tex. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. DA-AK02-68-C-0541.

—Bell Aerospace Corp., Fort Worth, Tex. $1,199,377. Tail booms for UH-1 helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

26—Automatic Switch Co., Florham Park, N.J. $1,945,333. Production of automatic switching units and spare parts for electrical updating of Minuteman Wing III, Minot AFB, N.D. Ballistic Missile Construction Office, Army Corp of Engineers, Norton AFB, Calif. DA-CA13-69-C-0010.

27—Murphy Brothers, Inc., Spokane, Wash. $3,982,593 Relocation of 10½ miles of forest development road, Libby Dam Project, Mont. Army Engineer District, Seattle, Wa. DA-CW67-69-C-0043.

28—Browning Construction Co., San Antonio, Tex. $1,239,700. Construction of clinical laboratory at Brooks AFB, Tex. Army Engineer District, Fort Worth, Tex. DA-CA63-69-C-0163.

—Chrysler Corp., Marysville, Mich. $1,089,820 Model 75M-1407 and HT 361-579 engines for V100 and M113 armored personnel carriers. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-2605.

—Cutler-Hammer, Inc., Deer Park, N Y. $2,581,510. AN/PPS-5 radar sets and ancillary items Army Electronics Command, Fort Monmouth, N J. DA-AB07-68-C-0432.

—Northrop Corp., Anaheim, Calif. $4,244,594. Warheads (WDU-4A/A) for 2.75 rockets Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0308.

—Varo, Inc., Garland, Tex. $1,012,330. Metascope assemblies (AN /PAS-6) and metascope viewers (SV-43/UAS-6) for night vision viewing. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0340.

—Uniroyal, Inc., New York, N.Y. $7,149,772 (contract modification). Production, loading, assembling and packing ammunition. Joliet Army Ammunition Plant, Joliet, Ill. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00002(A).

—Chamberlain Mfg. Corp., Elmhurst, Ill. $1,353,200 (contract modification). 152mm high explosive projectiles. Waterloo, Iowa. Army Procurement Agency, Chicago, Ill. DA-AA21-68-C-0691

—Electrospace Corp., Glen Cove, N.Y. $2,706,116. AN/TVS-2 night vision sights Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0329.

29—A. O. Smith Corp., Chicago, Ill. $8,151,300. Metal parts for 750-pound bombs. Bellmead, Tex., Birmingham, Ala and Milwaukee, Wis. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69 C-0308.

—Olin Mathieson Chemical Corp., New York, N.Y. $1,932,218. Manufacture, load, assemble and pack propellants. Charlestown, Ind. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173 AMC-00097(A).

—Supreme Products Corp., Chicago, Ill. $1,071,600. Metal parts for 750-pound bomb tail fuzes. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-60 C-0074.

—Bell & Howell Co., Chicago, Ill. $1,018,019. Metal parts for time fuzes for 81mm illuminating projectiles. Evanston, Ill. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0334.

—Chrysler Corp., Centerline, Mich. $7,742,500. System engineering management for M60A1E2 tank. Army Weapons Command, Rock Island Arsenal, Ill. DA-AF03-69-C-0087.

—Hughes Aircraft Co., Culver City, Calif $7,500,000. Limited production of Iroquois night fighter and night tracker (INFANT) systems. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0348.

—CONDEC Corp., Old Greenwich, Conn. $6,210,030. Pershing erector launchers. Army Missile Command, Redstone, Ala. DA-AH01-69-C-1817.

—Honeywell, Inc., Tampa, Fla. $1,765,422. 425 lightweight, full, duplex voice multiplexers (TD660/G). Philadelphia Procurement Div., Army Electronics Command. DA-AB05-69-C-1036.

—General Motors Corp., Detroit, Mich. $2,475,680. Diesel engines (6V53) for M113 vehicle series. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4362.

—J. A. Guy, Inc., Dublin, Ohio. $2,224,600. Construction of office and shop wings, Wright-Patterson AFB, Ohio. Army Engineer District, Louisville, Ky. DA-CA27-69-C-0043.

—AVCO Corp., Stratford, Conn. $1,166,532. (contract modification). T55-L-11 turbine engines for CH-47C. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-C-1853.

DEPARTMENT OF THE NAVY

1—Bendix Corp., Teterboro, N.J. $8,540,289. Inertial components for Poseidon guidance systems. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0081.

—Litton Systems, Inc., Culver City, Calif. $113,000,000. Construction of new-type multi-purpose amphibious warfare ships (LHA) Ingalls Shipbuilding Div., Litton Systems, Pascagoula, Miss. Naval Ship Systems Command, Washington, D.C. N00024-69-C-0283

2—Stewart and Stevenson Services, Inc., Houston, Tex. $2,082,190. Procurement of 2000 KW generator plants for the U.S. Naval Construction Battalion Center, Davisville, R.I. Naval Facilities Engineering Command, through U.S. Naval Construction Battalion Center, Davisville, R.I. N62578-69-C-0069.

—Singer-General Precision, Inc., Glendale, Calif. $1,560,909. Conversion of Mk 48 torpedo modification kits. Naval Ordnance Systems Command, Washington, D.C. N00017-68-C-1218.

—Lockheed Missiles and Space Co., Sunnyvale, Calif. $1,255,000. Conversion of FBM weapons training equipment at Dam Neck, Va., and Charleston, S.C., to Poseidon (C-3) training capability. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0013.

—K. Chavis General Contractor, Inc., Pensacola, Fla. $1,277,700. Construction of an industrial waste disposal facility at the Naval Air Station, Pensacola, Fla. Naval Facilities Engineering Command, through Southeast Division, Charleston, S.C. N62467-67-C-0422.

—Comprehensive Designers Inc., Culver City, Calif. $2,426,091. Engineering, drafting and technical writing services in support of the Point Hueneme Naval Ship Missile Systems Engineering Station programs. Naval Purchasing Office, Los Angeles, Calif. N00123-69-C-091.

5—Sydney Construction Co., Inc., Brookline, Mass. $2,885,000. Construction of 150 units of family housing at the Naval Air Station, South Weymouth, Mass. Naval Facilities Engineering Command, through Northeast Division, Boston, Mass. N62464-68-C-0002.

—Aerojet-General Corp., Sacramento, Calif. $1,776,828 Production of Mk 56 Mod O rocket motors. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2212.

—Western Gear Corp., Lynwood, Calif. $1,186,576. Drive train kits for SATS weapons loaders. Naval Air Engineering Center, Philadelphia, Pa. N00156-69-C-1646.

—Pennsylvania State University, University Park, Pa. $1,112,145. Research on Mk 48 torpedoes Naval Ordnance Systems Command, Washington, D.C. NOw 65-0123-d.

6—RCA Defense Electronic Products, Camden, N.J. $23,190,516. Manufacture of direction finder and countermeasures equipment. Naval Electronic Systems Command, Washington, D.C. N00039-69-C-2576.

—Newport News Shipbuilding and Dry Dock Co., Newport News, Va. $4,009,725 (contract modification). Furnishing of additional material and services required to prepare for the overhaul, repair, alteration and refueling of the USS Enterprise (CVAN 65). Naval Ship Systems Command, Washington, D.C. P011N00024-68-C-0203.

—Texas Instruments Inc., Dallas, Tex. $1,510,080. Spare parts for the RA-5C aircraft ANI AAS-21 infrared system. Naval Aviation Supply Office, Philadephia, Pa. N00383-69-A-1801-0010.

—Texas Instruments Inc., Dallas, Tex. $1,377,108. Spare parts for A-7 aircraft radar (AN/APQ 126). Naval Aviation Supply Office, Philadelphia, Pa. N00383-67-A-2001-0669.

—Southwestern Portland Cement Co., Los Angeles, Calif. $1,253,400. General purpose cement. Victorville, Calif. Naval Purchas-

ing Office, Los Angeles, Calif N00123-69-C-2209.

—Raytheon Co., Lowell, Mass. $5,367,598 (Increase in authorization limitation). Chapparal missile guidance and control groups for the Army. Naval Air Systems Command, Washington, D.C. N00019-69-C-0200.

—General Electric Co., Utica, N.Y. $3,515,-625. Airborne data processing systems. Naval Air Systems Command, Washington, D.C. N00019-68-C-0254.

—General Electric Co., Utica, N.Y. $1,914,-943 (increase of limitation authorization). Chapparal missile guidance and control groups for the Army. Naval Air Systems Command, Washington, D.C. N00019-69-C-0199.

—Sanders Associates, Inc., Nashua, N.H. $1,164,587 (Increase of authorization limitation). Classified electronic equipment. Naval Air Systems Command, Washington, D.C. N00019-69-C-0331.

7—Sewart Seacraft, Berwick, La. $2,007,832. Thirteen 50-foot fast patrol craft (PCF). Naval Ships Systems Command, Washington, D.C. N00024-69-C-0302.

—Sunstrand Corp., Rockford, Ill. $1,329,146 (contract modification). Constant speed drives for installation in A-7 aircraft. Naval Air Systems Command, Washington, D.C. N00019-68-C-0088.

—Electrospace Corp., Glen Cove, N.Y. $1,-047-006. Chaff dispensers. Naval Air Systems Command, Washington, D.C. N00019-69-C-0596.

8—Philco-Ford Corp., Fort Washington, Pa. $37,642,970. Maintenance, repair and operation of equipment and facilities for naval activities in I Corps area, Vietnam. Naval Facilities Engineering Command, Washington, D.C. N00024-69-C-0021.

—Admiral Systems Corp., Chicago, Ill. $4,-513,915. AN/ARC 51 radio sets used on various aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-69-C-2089.

—Walsh and Co., Anchorage, Alaska. $2,-356,953. Construction of station hospital, Adak, Alaska. Naval Facilities Engineering Command, through Northwest Division, Seattle, Wash. N62476-69-C-0080.

—Southeastern Construction Co., Charlotte, N.C. $1,909,700. Construction of a recruit processing facility, Naval Training Center, Orlando, Fla. Naval Facilities Engineering Command, Washington, D.C. N62467-67-C-0270.

—Raytheon Co., Portsmouth, R.I. $1,600,000. Modification to sonar equipments and supporting engineering services. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1294.

—LTV Electro Systems Inc., Salt Lake City, Utah. Test monitor control equipment for ground to air communication equipment. Naval Supply Center, Oakland, Calif. N00228-69-C-1518.

—Kilgore Corp., Toone, Tenn. $1,470,000. Aircraft parachute flares. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0152.

9—Litcom Systems, Inc., Melville, N.Y. $2,-429,150. Manufacture of eight OMEGA navigational transmitting sets. Naval Electronics Systems Command, Washington, D.C. N00039-69-C-0560.

12—McDonnell Douglas Corp., Long Beach, Calif. $26,883,980. TA-4J aircraft. N00019-69-C-0390. $21,598,084 (contract modification). A-4H and TA-4H aircraft. N00019-67-C-0090. $9,017,980 (contract modification). A-4K and TA-4K aircraft. N00019-67-C-0170. Work will be done at Long Beach and Palmdale, Calif. Naval Air Systems Command, Washington, D.C.

—LTV Aerospace Corp., Dallas, Tex. $2,381,-841 (contract modification). Services and materials to incorporate improvement changes on RF-8A aircraft. Naval Air Systems Command, Washington, D.C. N00019-68-C-0130.

—Spedcor Electronics, Inc., Glendale, N.Y. $1,896,216. Classified electromechanical beacons. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5469.

—Boeing Co., Morton, Pa. $1,595,395 (contract modification). CH-46D helicopters. Naval Air Systems Command, Washington, D.C. N00019-68-C-0391.

13—Honeywell, Inc., Minneapolis, Minn. $9,-263,790 (contract modification). Components for Rockeye II bombs. Naval Air Systems Command, Washington, D.C. N00019-69-C-0168.

—Hughes Aircraft Co., Culver City, Calif. $5,400,000 (contract modification). Increase of authorization limitation for Pheonix guided missiles, Tuscon, Ariz., and Culver City. Naval Air Systems Command, Washington, D.C. N00019-68-C-0296.

—Jenkins and Boiler, Inc., Waukegan, Ill. $1,148,000. Construction of addition to a recruit building, Naval Training Center, Great Lakes, Ill. Naval Facilities Engineering Command, Washington, D.C. N62465-67-C-0384.

—Galloway Co., Baldwin Park, Calif. $1,-404,610. Mk 115, Mod. O, high explosive bombs. Naval Air Systems Command, Washington, D.C. N00019-69-C-0608.

16—Sperry Rand Corp., St. Paul, Minn. $2,-401,347. Seven shipboard logistical computer systems. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1308.

—Reflectone Inc., Stanford, Conn. $1,580,555. Radar operator training complex (15-G-16) and radar target simulator device (15-G-16A). Naval Training Device Center, Orlando, Fla. N61339-69-C-0249.

19—American Machine and Foundry Co., York, Pa. $4,921,520. Mk 82 Mod 1 bomb bodies. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0341.

—United States Steel Corp., Pittsburgh, Pa. $3,741,600. Mk 82 Mod 1 bomb bodies. McKeesport, Pa. Naval Ships Parts Control Center, Mechanicsburgh, Pa. N00104-69-C-0340.

—Borg-Warner Corp., Chicago, Ill. $1,803,-072. Mk 82 Mod 1 bomb bodies. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0343.

—Intercontinental Manufacturing Co., Garland, Tex. $1,875,600. Mk 82 Mod 1 bomb bodies. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0343.

21—Raytheon Co., Sudbury, Mass. $9,888,888. Definitization of technical changes and procurement of MK-3 Poseidon electronics assemblies. Naval Strategic Systems Project Office, Washington, D.C. N00030-66-C-0159 Mod. P010.

—Reid and Hope, Suffolk, Va. $1,522,029. Construction of bachelor enlisted quarters, Norfolk Naval Shipyard, Portsmouth, Va. Naval Facilities Engineering Command, Washington, D.C. N62470-68-C-0528.

22—Hughes Aircraft Co., Culver City, Calif. $9,600,000 (contract modification). Incremental funding for Phoenix missile program. Naval Air Systems Command, Washington, D.C. N00019-67-C-0240.

—Boeing Co., Morton, Pa. $1,311,007. De-ice blankets for H-46 helicopters. Naval Aviation Supply Office, Philadelphia, Pa. N00383-68-A-5601-0736.

23—KDI Precision Products Inc., Cincinnati, Ohio. $1,234,000. Mk 51, Mod 5 fuzes for three-inch, 50 caliber projectiles. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0348.

26—United Aircraft Corp., Stratford, Conn. $11,540,290. HH-3E helicopters for the Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0355.

—Litton Systems, Inc., Woodland Hills, Calif. $2,965,846. Carrier Aircraft Inertial Navigation Systems (CAINS). Naval Air Systems Command, Washington, D.C. N00019-69-C-0582.

—McDonnell Douglas Corp., St. Louis, Mo. $1,700,000. Parts and equipment for F-4C and RF-4C aircraft for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019-68-C-0495 Mod P090.

—American Air Filter Co., Inc., St. Louis, Mo. $1,004,990. Trailer-mounted air conditioning units for maintenance and preflight checkout. Naval Air Systems Command, Washington, D.C. N00019-69-C-0682.

—Radiation Systems Inc., McLean, Va. $2,-940,545. Design, development, fabrication and testing of components, developmental and prototype guidance sections, and associated support equipment for Shrike (AGM-45A-8) anti-radiation missiles. Naval Purchasing Office, Los Angeles, Calif. N00123-69-C-2115.

—General Steel Tank Co., Reidsville, N.C. $1,310,400. Construction of four high-capacity amphibious assault fuel systems. Headquarters, U.S. Marine Corp, Washington, D.C. N00027-69-C-0180.

27—Sperry Rand Corp., Great Neck, N.Y. $2,-500,000 (contract modification). Modernization of Mk 119 (Mods 0 and 5) computers. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2325.

—R.D. Lambert and Son, Inc., Chesapeake Va. $2,094,560. Construction of and aircraft overhaul and repair facility, Naval Air Rework Facility, Naval Air Station, Norfolk, Va. Naval Facilities Engineering Command, Washington, D.C. N62470-68-C-0486.

—Collins Radio Co., Cedar Rapids, Iowa. $2,261,641 AN/ARC-51 radio sets for aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383 69-C-2093

—Dillingham Corp., DBA Hawaiian Dredging and Construction Co., and Al Johnson Construction Co., Honolulu, Hawaii. $1,865,900 Improvement of Drydock No. 2, Naval Shipyard, Pearl Harbor, Hawaii. Naval Facilities Engineering Command, Washington, D.C. N62471 69-C-0333.

—Electronic Specialty Co., Thomaston, Conn. $1,338,050. 25 electric motor generator sets and associated control equipment Naval Ship Systems Command, Washington, D C N00024-69-C-5327.

—Sperry Rand Corp., St. Paul, Minn. $1,-044,651. Computers and associated repair parts. Naval Ship Systems command, Washington, D.C. N00024-69-C-1309.

—Gibbs Manufacturing and Research Co., Janesville, Wis. $1,000,309. Production of ignition separation assemblies (Mk 3-1) for Asroc missiles. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-1437.

28—Grumman Aircraft Engineering Corp., Bethpage, N.Y. $1,146,000. Building maintenance at Naval Weapons Industrial Reserve Plant at Bethpage. Naval Air Systems Command, Washington, D.C. N00019-69-C-9048.

—Northrop Corp., Newbury Park, Calif $4,456,171 (contract modification). MQM-74A target drones. Naval Air Systems Command, Washington, D.C. N00019-69-C-0306.

—Kaman Corp., Bloomfield, Conn. $1,632,000 (contract modification). Parts and equipment for conversion of UH-2A/B helicopters to UH-2C twin-engine configuration. Naval Air Systems Command, Washington, D.C. N00019-69 C-0066.

—Hazeltine Corp., Little Neck, N.Y. $1,165-750 Classified electronic equipment for the Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0557.

29—McInnis Brothers, Inc., Minden, La $3,720,-047. Construction of medical facility at Barksdale AFB, La. Naval Facilities Engineering Command, Washington, D.C. N62468-67-C-0336.

—Farmers Tool & Supply Corp., Denver, Colo. $2,587,435. Wings and roller on assemblies for Sidewinder and Chaparral missiles. Naval Ordnance Station, Indian Head, Md N00174 69-C-0627.

—H. W. Stanfield Construction Corp. and S. L. Haehn, Inc. (joint venture), San Diego, Calif. $2,069,971. Construction of barracks at Naval Training Center, San Diego. Naval Facilities Engineering Command. N62473-68 C-0122.

—Pyrotector, Inc., Hingham, Mass $1,111,-532. Fire-suppression equipment and related data for Marine Corps amphibious vessels. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5488.

DEPARTMENT OF THE AIR FORCE

1—Sperry Rand Corp., St. Paul, Minn. $1,-000,000 Design and development of a Minuteman weapon systems computer. Space and Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701 69-C-0111.

—Sperry Rand Corp., Salt Lake City, Utah $1,700,000. Preproduction planning and long lead time materials for production of YQU-22A aircraft. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-1148.

—Textron, Inc., Grants Pass, Ore. $1,205,-400. Production of multiple ejector racks

for A-7D and F-4 aircraft. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-69-C-3320.

—Hughes Aircraft Co., Fullerton, Calif. $1,000,000 Prototype testing of a wide band array radar. Rome Air Development Center, (AFSC), Griffis AFB, N.Y. F30602-69-C-0309.

2—McDonnell Douglas Corp., St. Louis, Mo. $3,133,000. Modification of RF-4C aircraft. Robertson, Mo. Odgen Air Materiel Area, (AFLC), Hill AFB, Utah. F34601-68-A-2019.

6—General Electric Co., Burlington, Vt. $1,243,000. Production of ammunition storage drums. Armament Development and Test Center, (AFSC), Eglin AFB, Fla. F08635-69-C-0014.

7—Goodyear Aerospace Corp., Akron, Ohio. $2,050,000 Production of radar bombing systems. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33615-69-C-1569.

12—Lasko Metal Products, Inc., Chester, Pa. $3,648,879. Production of fin assemblies for 750-pound bombs. Pittston and West Chester, Pa. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-3171.

—Kollsman Instrument Corp., Syosset, N.Y. $2,356,000. Aerospace ground equipment (AN/USQ-28) for RC-135 aircraft. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0800.

13—Partner Industries of America, Inc., Chicago, Ill. $1,150,205. 71 fire trucks and spare parts. Appleton, Wis. Warner Robins Air Materiel Area, (AFLC) Robins AFB, Ga. F09603-69-C-3372.

16—Hughes Aircraft Corp., Culver City, Calif. $1,499,500. Modification of Falcon (AIM-4D) missiles and related aerospace ground equipment. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0589.

19—Modulux, Inc., Newark, Calif. $1,084,440 (contract modification). Production of modular relocatable buildings. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603 69-C-1645-P004.

20—Lockheed Aircraft Corp., Sunnyvale, Calif. $1,016,000. Prototype development and testing of a space vehicle navigation and guidance improvement system. Space and Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0150.

—Lockheed Aircraft Corp., Marietta, Ga. $1,016,543. Full-scale fatigue test program of C-130B through E series aircraft. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-68-C-2956.

21—Chromalloy American Corp., New York, N.Y. $2,358,449. Repair and coating of J-57 and J-75 engine turbine nozzle guide vanes. West Nyack, N.Y. San Antonio Air Materiel Area, (AFLC) Kelly AFB, Tex. F34601-68-A-2091.

27—General Electric Co., West Lynn, Mass. $5,300,000. CY 69 component improvement program for T-64 engine series. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0385-P001.

29—Cable Communication System, Inc., Cambridge, Mass $1,642,107. Engineering and furnishing submarine cable system between Sitka and Lena Point, Alaska. Cambridge and Portsmouth, N.H. Air Force Systems Command, Andrews AFB, Washington, D.C. F45033-69-C-0087.

—Hughes Aircraft Co., Canoga Park Calif. $3,110,900. Production of components for Falcon missiles. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C 1014.

—Cessna Aircraft Co., Wichita, Kan. $11,682,000. Procurement of O-2A aircraft, aerospace ground equipment, spare parts, and data. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-PZ26).

OFF-SHORE PROCUREMENT

29—Canadian Commercial Corp., Litton Systems, Ltd., Rexdale, Ontario. $1,204,046. Procurement of weapons release control systems (ANASQ-91) for F-4D/E aircraft. Aeronautical Systems Div., (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-0634-POO5.

Navy Lets Contract for New LHA Ships

The Navy has awarded a contract for construction of a new class ship to the Ingalls Shipbuilding Division of Litton Systems, Pascagoula, Miss. The $113.9 million contract provides for the construction of one multi-purpose amphibious warfare ship (LHA) and a long lead time for the second and third ships. A total of nine LHAs has been called for in the multi-year, billion dollar proposal. Delivery of the first ship is expected in spring 1973.

Faster and more versatile than any amphibious warfare ships now in the Fleet, the LHA will perform missions now requiring four different types. As large as an Essex-type carrier, the LHA combines the features of the amphibious assault ship (LPH), the amphibious transport dock (LPD), the amphibious cargo ship (LKA), and the dock landing ship (LSD). The LHA will be capable of transporting and putting ashore an entire Marine battalion landing team, with their combat equipment.

Incorporated into the ships will be new safety, propulsion and command facilities. A fire detection system will sense the presence of products of combustion in addition to temperature. The steam propulsion plant will be automated, with a remote location central control system and built-in logic circuitry to handle engineering casualties automatically.

In addition, command and control facilities will include semi-automated communications systems, and all-weather traffic and approach control facilities are provided for the helicopters and boats. A special acclimatizing gym will provide either arctic or tropic weather conditioning for the Marine battalion. Medical facilities include three operating rooms and a 300-patient sick bay.

The proposed nine LHAs represent considerable cost savings, according to the Navy. Some 21 specialized amphibious warfare ships will be deleted from the Navy's five-year plan, and three Boxer-type LPHs and some older amphibious ships will be retired when the LHAs join the Fleet.

The project manager for the LHA program is Captain R. F. Wilkinson of the Naval Ships Systems Command, Washington, D.C.

Navy's New Gunpowder Reduces Weapon Wear

A new type of gunpowder called NACO (Navy Cool), which burns at temperatures 300 degrees cooler than standard gunpowder, has been developed by the Naval Ordnance Station, Indian Head, Md.

As a result of the reduced heat, shipboard gun wear has been cut in half. Since the liners inside the barrels of naval guns must be replaced periodically because of the erosion caused largely by heat, the development of NACO means that combatant ships can stay on the firing line for longer periods.

Another important advantage of NACO is the elimination of most of the muzzle blast and smoke usually associated with gunfire. This feature diminishes the damage caused by gunfire on delicate shipboard equipment, especially electronic components.

The virtual absence of flash and smoke provides the Navy, for the first time, with a universal propellant suitable for round-the-clock operations. Ships will no longer need to use two kinds of gunpowder to prevent detection: a smokeless-type for daytime missions and a flashless type for nighttime use. NACO will serve both purposes.

NACO propellant is now used by the Navy's five-inch .54 caliber guns. Development is also underway for use of the new propellant on other Navy weapons, including the 16-inch guns of the battleship USS New Jersey.

Changing Address?

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DSA Establishes Control Point for Quality Assurance To Service Foreign Buyers

Foreign governments, international organizations and foreign military contractors, authorized by the U.S. Government to procure military supplies in the United States, now have a single point of contact for quality assurance.

According to a recently instituted system, the Defense Contract Administration Services Region (DCASR) New York, 60 Hudson St., New York, N. Y. 10013, a field activity of the Defense Supply Agency, has been designated as the central control point for quality assurance services on direct foreign military procurements.

In the past the foreign buying activities have had to deal with several offices of the Military Services for administration of contracts.

Under the new central control point concept, the foreign representative gets in touch with DCASR New York as soon as a contract has been made with industry. DCASR New York then places the quality assurance for the work with the DCAS regional office responsible for the plant involved, or with a Military Service if the plant is under one of the Services for contract administration.

When the quality assurance service is completed, the DCAS region or the military office involved reports the time and cost of the service to DCASR New York. DCASR New York then bills the foreign government for the cost of the service. Payment for the goods is handled between the foreign government and the American contractor.

There are exceptions to the new central control point program, however. Canadian purchases in the United States and direct procurements for which a Military Department is the executive agent will continue under the terms of seperate agreements. NATO'S Maintenance and Supply Agency will deal directly with the activity responsible for the supplier.

The Defense Supply Agency expects the central control point concept to eliminate confusion and facilitate the quality assurance of military items produced for foreign buyers.

The concept is the latest addition of unified service in the administration of contracts.

Army Calls for "Waterwings" for Combat Troops

The Army Combat Developments Command (CDC), Fort Belvoir, Va., is seeking a 10-ounce inflatable flotation device capable of supporting 250 pounds—the equivalent of a soldier and his equipment—for use in combat.

The flotation device is in answer to needs from the field, and is seen as invaluable for troops engaged in water operations, such as those in Vietnam's Mekong Delta. The device, according to the CDC Letter Requirement, would be worn with combat gear, be lightweight, compact, reuseable and reinflatable. In addition, it would make it impossible for the wearer's head to go under water.

The proposal calls for ease of inflation/deflation and packaging. The device would be constructed in two or three bladder-like compartments, repairable or replaceable at the squad level.

Ideally, the flotation device would allow the soldier in the water to fire his weapon, and several of the devices would be joinable to form a raft to further serve soldiers in water operations.

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The *Bulletin* serves as a means of communication between the Department of Defense, its authorized agencies, defense contractors and other business interests. It provides guidance to industry concerning official DOD policies, programs and projects and seeks to stimulate thought on the part of the Defense-Industry team in solving problems allied to the defense effort.

Suggestions from industry representatives concerning possible topics for future issues are welcomed and should be forwarded to the Editor at the address shown below.

The *Bulletin* is distributed free of charge to qualified representatives of industry and of the Departments of Defense, Army, Navy, and Air Force. Subscription requests should be submitted on company letterhead stationery, must indicate the position title of the requestor and be addressed to the Editor, Defense Industry Bulletin, OASD (PA), Pentagon, Washington, D. C. 20301.

IN THIS ISSUE

FEATURES

DEPARTMENTS

The rapid emergence of the helicopter as a major weapon system in the Army inventory has caused a virtual rewriting of the tactical rule book. Opportunities for exploiting these versatile craft in combat have brought concomitant problems in the avionics area. These problems—and proposed Army solutions—are discussed in "Army Helicopter Avionics," featured in this issue.

Present-day ground warfare has expanded from the conventional dawn-to-dusk limited operations to continuous, 24-hour, full scale operations. For airmobile tactics the implication is clear: significant aviation electronic equipment improvements are required for night and adverse weather flight operations in order to increase the effectiveness of the ground forces.

The current Army inventory includes both fixed and rotary wing aircraft systems. Rotary wing systems include the UH-1 (Iroquois) series utility transports; the CH-47 (Chinook) series light tactical transports; the OH-6A (Cayuse) and the OH-58A light observation helicopters; the AH-1G (Cobra) attack helicopter; and the CH-54 (Flying Crane).

Fixed wing aircraft systems include the OV-1 (Mohawk) series surveillance aircraft, and the U-8 and U-21 utility and special mission aircraft.

These rotary and fixed wing aircraft systems, with the exception of a limited number of specially equipped vehicles, contain non-integrated avionics systems made up of various functional black boxes and having limited capability for continuous operations.

Several future (near term) aircraft systems are now in concept formulation, or in the early planning phase:

- Utility Tactical Transport Aircraft System (UTTAS).
- Heavy Lift Helicopter (HLH).
- Manned Aerial Vehicle for Surveillance (MAVS).
- Light Tactical Transport Aircraft System (LTTAS).

The UTTAS, HLH, MAVS and LTTAS are proposed replacements for the UH-1, CH-54, OV-1 and CH-47, respectively. To these last four aircraft systems we assign highest priority in terms of providing improved avionics capabilities.

Avionics systems or components evolving from any of these system development programs may be considered for application to present aircraft systems during phased rebuild programs, but only on a cost-effective basis.

The avionics for UTTAS and any other new aircraft systems should be "Integrated Ground-Airborne Avionics Systems." There should be integration and functional modularity within the aircraft and on the ground, among multiple aircraft, and between aircraft and the ground. The extent of integration and/or confederation will depend ultimately upon time, technology, cost, and effectiveness considerations. These advanced avionics systems will consist of modular and integrated computation (central or confederated), multipurpose sensors and displays, and standard digital interface between sensors, computation, displays, and controls.

The main thrusts of this integrated systems approach are embodied in the modular design concept which will provide:

- Enhanced mission reliability through the implementation of graceful mode degradation. (The system must be designed to sustain a reasonable degree of combat damage and still continue to function.)
- Increased commonality and standardization, through the use of complete systems or portions thereof, in both sophisticated and less comple[x] Army aircraft systems, across th[e] tactical fleet.
- Standard digital interface (format, levels, rates, etc.) between sensors, computation elements, displays and controls.
- Improved future growth potential and flexibility, without major redesign and retrofit, to afford easy interchange and/or addition of sensors. (The avionics system fielded with a new aircraft will very probably change significantly during the useful

life of the aircraft.)

• Increased mission and cost effectiveness by allowing subsystems, not required for a mission, to be removed from the system without affecting the operation of other system functions.

• Significant gains in terms of weight, reliability, vulnerability, and other system characteristics, versus a non-integrated macro-system (or black box) approach for a given technology base.

Scope of Technical Effort

The major technical areas of effort that are required to achieve these goals must include systems engineering and man-machine interface; technology improvement; and system effectiveness measurement. These four areas must be addressed by the Government to provide guidance to industry during concept formulation and for contract definitions.

Systems Engineering.

Systems engineering includes systems analyses, synthesis, simulation and, ideally, feasibility flight test demonstration. System analyses are required by the developing agency to translate those operational requirements, embodied in the applicable aircraft system Qualitative Materiel Development Objective (QMDO) and pertinent Army Combat Developments Command studies, into technical characteristics.

Systems syntheses are also required to define avionics system and subsystem specifications, identify candidate technology for tradeoffs, identify candidates for technology improvements (in size, weight, power consumption, cost and reliability), and identify technology gaps. The output of these efforts will enhance logistic commonality for the Army across the aircraft fleet, insure that problems peculiar to the Army (improved air-ground interactions, map-of-the-earth operations, etc.) are adequately addressed, and identify discrete technical characteristics.

Man-Machine Interface.

Early definition of an acceptable crew station layout is required in order to guide industry through the various phases of the development cycle leading toward the fielding of the first operational unit. The Army pilot is unique in that he must be capable of flying not just one type aircraft but, in many cases, virtually any within the inventory. Therefore, a thorough analysis is required to maximize commonality of aircraft system crew stations and, ultimately, minimize transition training difficulties from one aircraft to another.

Crew station design can be accomplished initially in the simulation phase of system engineering and in the feasibility flight test phase. While simulation does provide a carefully controlled laboratory environment, in which exact cause and effect relationships can be quantitatively established, simulation does not eliminate the need for real-world feasibility flight tests. Feasibility flight tests are performed with an in-service test bed aircraft, and existing hardware, to prove conceptual feasibility.

Technology Improvements.

The technology program is a dual effort. For those avionics subsystems whose performance borders on or has reached the tactical payoff limit (*e.g.*, radar altimeters, doppler velocity sensors, communications transceivers, etc.), the major thrust of technology enhancement will be directed toward significant reductions of size, weight, power consumption and cost, and improvement of reliability. In those areas where technology or operational experience is not as extensive (*e.g.*, gunfire detectors, steep approach and landing, obstacles sensors, etc.), the thrust of technology will be to obtain the best level of performance capability within a specified time frame.

System Effectiveness.

It is vital that the Government identify effectiveness criteria, in terms of critical performance parameters, their boundary limits, and the sensitivity of total aircraft system mission performance to changes in these parameters. These criteria are just as necessary for avionics as they are for airframe, fire control, and weapons. These criteria must be provided to industry in concept formulation, so that the sensitivities of the avionic performance requirements are understood and can be applied in tradeoff decisions. Further, the Government must use these criteria, preferably in the form of an effectiveness model, as a yardstick to adequately and fairly judge competitive contract definition phase proposals in accordance with a well defined frame of reference.

Government-Industry Interface

Government and industrial efforts are performed by and through appropriate Army Material Command subordinate commands and the applicable project manager. During concept formulation, the Government must perform and/or support operational analyses to define system operational requirements, and mission and performance envelopes. Further, the Government must translate these operational requirements into technical characteristics. The required concept formulation systems engineering, man-machine interface, technology candidate developments, and system effectiveness modeling are performed by appropriate government and industrial groups.

Industry is required to pay particular attention to parametric design studies for alternative system approaches and tradeoff decisions.

UTTAS is presently in the concept formulation phase. More comprehensive concept formulation investigations are planned for the MAVS project which will involve flight test demonstrations, procurement of prototype equipment, integration of contractor- and government-furnished equipment in test bed aircraft, flight testing and data reduction of test re-

Raymond R. Hefter is Staff Assistant for Advanced Planning to the Director of the Avionics Laboratory, U.S. Army Electronics Command, Fort Monmouth, N. J. His background in systems engineering and technical management includes the OV-1 reconnaissance/surveillance aircraft systems and the AH-56A advanced aerial fire support system. Mr. Hefter holds a B. S. degree in physics from Muhlenberg College.

sults, as well as parametric design and tradeoff studies.

Since funding for concept formulation studies is normally small compared to total program costs and with the anticipated contract definition phase, industry investment in those internal research and development activities to improve its competitive position often occurs. This applies to potential vendors for all aircraft subsystem equipments, as well as potential prime contractors.

The breakout of contractor-furnished equipment (CFE) versus government-furnished equipment (GFE), determined during negotiations with the contract definition contractors, could result in complete CFE, complete GFE, or an intermix of each. This subject has received much attention in the last few years but always should be decided on the basis of which (CFE or GFE) is best for the Government. For the Army, commonality across the fleet is obviously desirable, if not mandatory, in order to reduce to a minimum the maintenance and logistics tail in an airmobile environment.

Problems in Helicopter Avionics

It is the purpose of airborne avionics to enhance the capability of the crew to perform various missions (transport, weapons, surveillance, command control, etc.) in the most efficient and cost-effective manner. This should be the criteria in the design, development and evaluation of all avionics.

Since the Army's principal tactical airmobile vehicle is, and will most likely continue to be, the rotary wing aircraft, it is important that we examine those major characteristics and uses which are unique to such vehicles and which impose constraints on airborne avionics design. These constraints are categorized in three major groupings.

Physical Constraints.

The major physical limitations of helicopters as aircraft include inefficient lifting characteristics, inherent instability, and relatively wide speed ranges. The lift capabilities and, therefore, the useful load limitations of helicopters, as compared to fixed wing aircrift, are well known. In general, helicopter use in tactical operations places a premium on weight reduction to a far greater degree than in other air vehicles. In order to increase reliability and reduce weight, size and electrical load requirements in airborne electronics for Army aircraft, application of solid state devices, microelectronics, and flush-mounted antennas have been applied to communications equipment. The Standard Lightweight Avionics Equipment (SLAE)—formerly identified as the Light Observation Helicopter Avionics Package (LOHAP)—has resulted in a weight saving of about 55 pounds over that of the "standard" equipments for VHF–FM, VHF–AM, UHF–AM, intercommunications and Automatic Direction Finder (ADF), or 45 pounds versus 100 pounds.

In meeting the challenge of providing significant improvements in night and adverse weather flight operations, as mentioned at the outset, application of these techniques (and others yet to evolve) to the other avionics functions of navigation, instrumentation, environment sensing (terrain avoidance, formation flight), landing and air traffic regulation must be made. Although microelectronics have been applied in the design of many of these subsystems and are available today, *e.g.*, the Integrated Helicopter Avionics System (IHAS) further improvements can be made by designing multipurpose sensors, and through the application of large-scale integrated circuits to the current generation of subsystems.

The alleviation of inherent problems, associated with current rotary wing aircraft, can be more efficiently provided by electronic techniques than by mechanical and/or electromechanical combinations. This is true to an even greater degree when advanced VTOL aircraft systems are considered or when applying automatic IFR flight modes to "conventional" rotor craft, both requiring dynamic control through a computer-aided outer loop or automatic flight path control system. Therefore, in order to unburden the pilot and provide greater efficiencies in flight and mission accomplishment in the more demanding environmental modes of operation envisioned for the near-term and longer-range systems, highly reliable electronic flight control systems (fly-by-wire) coupled with integrated computation and displays are required.

Environmental Constraints.

The spectrum of vibration frequency found in helicopters include those encountered in fixed-wing aircraft of 25cps and above and also the lower range, down to 4 or 5cps. Double displacement amplitudes as great as 0.1 inches are also encountered at numerous resonances. Vibrational environments of these kinds have resulted in many operational equipment failures and mechanically induced electronic interferences. Emphasis on the application of increased reliability requirements and reliability testing of new equipment will assist greatly in reducing these problems. Development of vibration isolators, which can cover the full spectrum of vibration/amplitude ranges encountered, may also assist.

High ambient cockpit noise, either in an enclosed cockpit or with open cockpit doors, as encountered in some armed helicopters present both a human factors and an inter-crew communications problem. Notch-type microphone filters and selective sound proofing are current solutions to improve crew comfort, reduce fatigue, and improve the quality of communications (air-to-air, air-to-ground and intercrew). The development of improved airframe soundproofing and new contact microphones (skull or throat types) are further possible solutions.

Turning rotors have caused rotor modulation interferences to ADF and Visual Omni Range (VOR) equipments, and the effect on high frequency equipments is still somewhat undefined. Induced low frequency interference and aircraft antenna masking and reflections still exist. Normal downwash effects over the fuselage makes aerodynamic instrumentation almost impossible during flight and hover. Flying sand, dust and stones during lift-off, hover, ground taxi and landing add operational and maintenance woes. Although not its primary purpose, pierced aluminum planking has helped somewhat in regard to sand and dust. The elimination and/or compensation of rotor modulation and the development of new types of mechanical and/or electrical aerodynamic instrumentation still pose real challenges.

Static electricity buildup in flight and during hover may produce low frequency navigation interference and personnel safety hazards during

(continued on page 22)

Procurement of Life-Supporting Supplies for the Armed Forces

Brigadier General William M. Mantz, U!

Proper clothing, good meals, and medical supplies are vitally important to each soldier, sailor, marine and airman in military service. Procurement and distribution of these life-supporting supplies—clothing, food and medical materiel—is the mission of the Defense Personnel Support Center, 2800 S. 20th St., Philadelphia Pa., a field activity of the Defense Supply Agency.

Common-use supplies procured by the Defense Personnel Support Center (DPSC) range from socks, underwear, uniforms, footwear, various types of military rations and drugs to highly sophisticated hospital equipment.

Approximately 27,800 items in the military part of the Federal Catalog are centrally managed by DPSC. Inventory in the three commodity areas at the end of 1968 was about $1.4 billion. Issues or sales to customers during FY 1968 totaled $2.33 billion, and the center's obligations amounted to $2.1 billion.

Organization and Operation

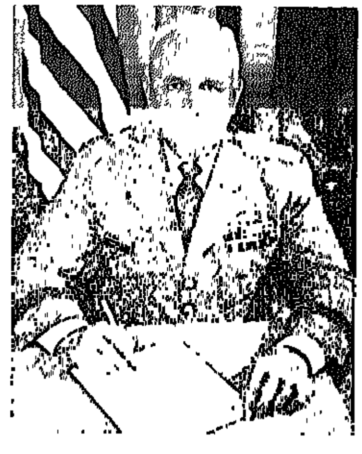
The Defense Supply Agency (DSA) established the Defense Personnel Support Center in July 1965 by moving the Defense Subsistence Supply Center from Chicago, Ill., and the Defense Medical Supply Center from New York City, and consolidating them with the Defense Clothing and Textile Supply Center at Philadelphia. The new DPSC was established with its present commodity-functional organization, including organizational elements for determination of supply requirements, technical quality assurance, procurement, and the necessary administrative elements, such as legal, comptroller, personnel, etc. DPSC also operates a clothing factory which manufactures orders normally too small for industry contractors, pilot models for research and development, and special measurement garments. The in-house factory provides capability for immediate response to urgent demands, and furnishes production and design technology to contractors.

Clothing, textiles, and medical supplies are procured by DPSC at Philadelphia, but most food items are bought through Subsistence Regional Headquarters organizations strategically located throughout the United States. Addresses of DPSC Subsistence Regional Headquarters are:

- Chicago—536 S. Clark St., Chicago, Ill. 60605.
- Kansas City—607 Hardesty Ave., Kansas City, Mo. 64124.
- Los Angeles—Federal Building, 312 N. Spring St., Los Angeles, Calif. 90012.
- New Orleans—4400 Dauphine St., New Orleans, La. 70140.
- New York—Third Ave. and 29th St., Brooklyn, N. Y. 11232.
- Oakland—2155 Webster St., Alameda, Calif. 94505.
- Richmond—c/o Defense General Supply Center, Richmond, Va. 23219.
- Seattle—Pier 91, Seattle, Wash. 98119.

To assure the quality of everything DPSC buys, specifications provided by the Military Services are used when solicitations are issued to industry. After a contract is awarded, DSA's Defense Contract Administration Services (DCAS) organization administers the contract, with primary responsibility for insuring contractor compliance with specifications. Technical assistance is provided to DCAS by the center, when requested. Most of DCAS quality assurance technical people are in day-to-day contact with contractors, and they are backed up by engineers and product specialists who are avaiable when new or unusual problems arise. Also, DC has recently developed a quality au providing for an independent prod evaluation by personnel other than individuals directly responsible inspection and acceptance.

While the volume of business a the center's concern for quality essential ingredients of supply ma agement, achievement of efficiency a economy are also major elements concern. That part of the story c best be illustrated by relating t



Brigadier General William M. Mantz, USA, has been Commander of the Defense Personnel Support Center, Defense Supply Agency, since November 1967. Before this assignment, he served as Commanding General, U. S. Army Natick Laboratories, Natick, Mass., and, during his tenure there, General Mantz assumed additional duty as Commanding General, Army Materiel (Mechanics) Research Command, Watertown, Mass. General Mantz holds a B.A. degree from Whitman College, and an M.B.A. degree from George Washington University.

DEFENSE PERSONNEL SUPPORT CENTER

2800 S. 20th St.
Philadelphia, Pa. 19101
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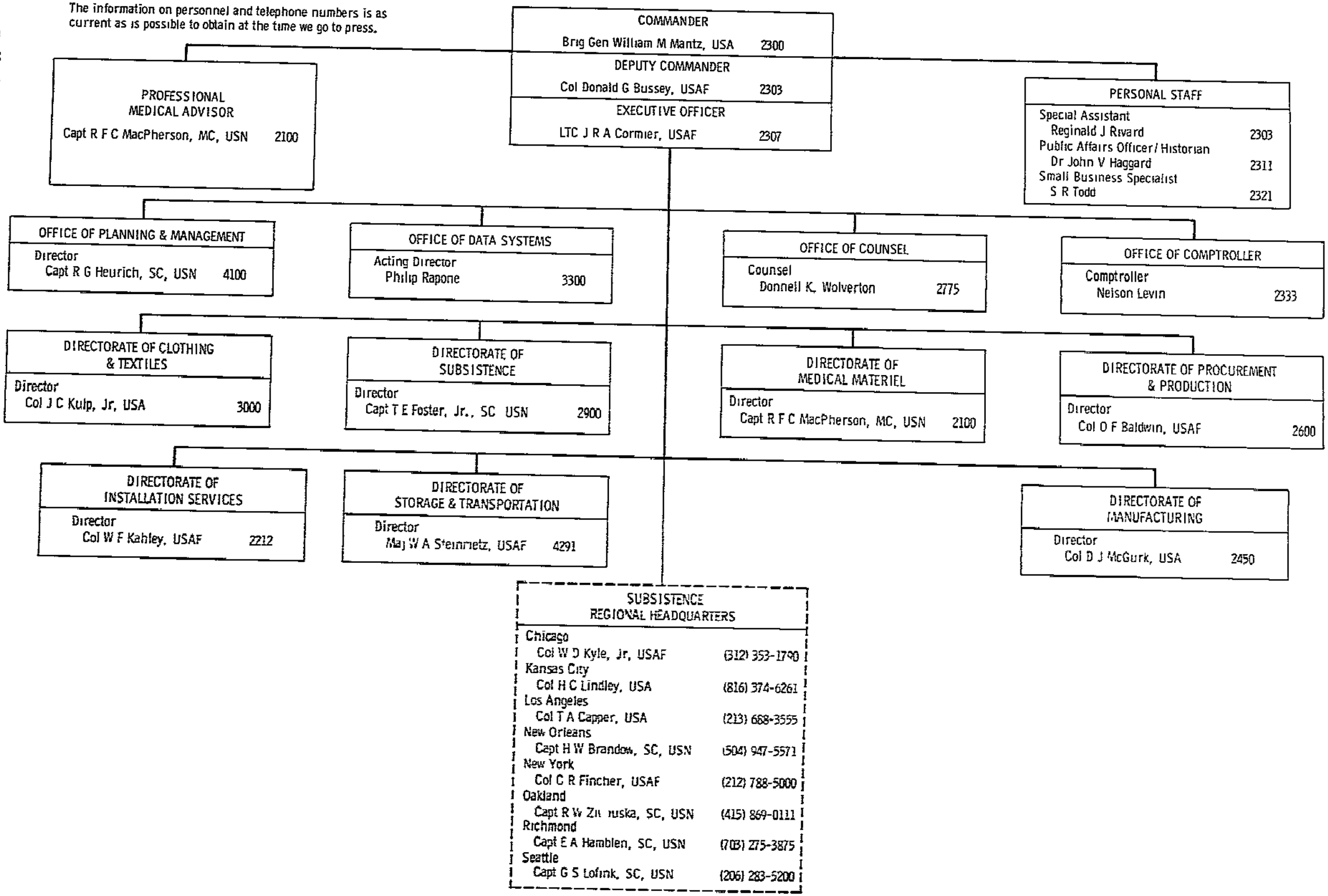
Editor's Note Organization charts appearing in the Bulletin are edited by the editorial staff to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizational elements not involved in the DOD-industry relationship have been eliminated because of space limitation.

The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.



development of the supply situation since July 1965 and the savings made during this period.

Two Major Problems

In the summer and fall of 1965, the center was faced with two major problems simultaneously. First, there was the transfer of the subsistence headquarters operation from Chicago to Philadelphia, and the medical materiel activity from New York. At the same time came the initial shock of the Southeast Asia buildup and its rapidly mounting supply requirements. Loss of trained personnel resulting from the consolidation added to the criticality of the problems.

At the time of consolidation in 1965, the three commodities were incompatible insofar as automatic data procedures, formats, criteria, and other details in the billing of customers were concerned. By March 1966, however, one system had been developed for all three commodities. As a result of this development, 32 computer programs were eliminated.

By the end of the first fiscal year, nsolidation had been successfully complished. However, by that time, pply demands from Southeast Asia id mounted to almost unmanageable roportions. For example, the demand or Meal Combat Individual (the modern version of the "C" ration of World War II) jumped from 28,872,-000 in FY 1964 to 154,266,000 in FY 1966. The center obligated $1,314.4 million for food, clothing and medical materiel in FY 1965. In FY 1966, it obligated $2,684.2 million for these commodities, doubling total procurements in a brief span of 12 months.

Acceleration of the Vietnam fighting came at a time when the center's stocks in the three commodity areas were relatively low. There were inadequate mobilization stocks, primarily because of budgetary limitations. Furthermore, the clothing industry was going through the most unprecelented boom in the national economy. Thus, the center was trying to support a war under peacetime conditions.

As a result of the shortage of onhand stocks and the problems of consolidation of three centers into one, supply performance suffered during he first six months in FY 1966.

By the early months of calendar 'ear 1968, the center had solved most f its supply management problems, nd percentages in stock availability, on-time fill, and backorders had reached normal peacetime levels.

Feeding the Troops in Vietnam

In supplying perishable food to Vietnam, the problem was not lack of availability, but rather lack of in-country refrigeration capacity in Vietnam, lack of a sufficient number of reefer vessels in which to ship items that must be kept under refrigeration, and loss of shelf-life during the long ocean voyage. This situation persisted for a period of about 16 months, but has now been alleviated by improved in-country facilities and increasing use of refrigerated container shipment.

The support and cooperation of American industry in no small measure aided the solution of problems to meet the military subsistence needs in Southeast Asia. Since the early days of the Vietnam buildup, the food industry has been requested to supply non-perishable military subsistence in completely unitized loads, protected against rough handling and prolonged outdoor storage in a tropical atmosphere. All non-perishable food supplies destined for Southeast Asia must be loaded on high quality four-way pallets, produced according to requirements of rigid military specifications. The unit containers—tin cans—must be OD coated and packed in solid fiber, water-resistant cases; these cases must then be placed on pallets protected by a polyethylene shroud and encased in solid fiberboard sheating; and, finally, they must be strapped to the pallet itself.

All of these requirements have created many problems for an industry which is normally geared to short transportation hauls, short storage periods, and quick turnover in the commercial market.

The box industry had to convert from the manufacture of corrugated fiberboard to solid water-resistant V-Board. It had to manufacture great quantities of water-proof plywood. Pallet manufacturers had to convert from the production of relatively inexpensive lightweight pallets of soft wood to sturdy pallets of hard wood.

Another major problem was the sudden requirement for many food items which had not been procured in quantity since the days of the Korean War. Included among them a wide range of operational and combat rations and great quantities of canned meat products. Specifica had to be quickly updated to reco new technology and processing n ods developed by industry during period since the Korean War. Al through efforts of government scientists and the unlimited coo tion of industry technologists, operation was accomplished with patch.

Solving the Clothing Needs

In the clothing area, the intro tion of new items particularly suit for the Southeast Asia environ also presented problems. The li weight tropical uniform, which been initially standardized in 1963 the Army Special Services Forces, promptly adopted by the Army, Force and Marine Corps. The di molded sole tropical combat boot became a high-demand item. Army and Marine Corps placed ceedingly high demands for this b The boot was first procured in 1 but as late as 1965 there was only manufacturer in the country could produce it, and he was mak only 50 pairs a day.

A second phase of this cloth problem area was the magnitude requirements for some 15,000 it with military characteristics, most which are not used by the civil population. To get the required s plies on time, the center intensi its internal integrated operati among item managers, technical s calists, and contracting officers. then worked closely with the Milit Services to reduce unit allowances servicemen, and to reduce stock lev in posts, camps and stations. Wh ever necessary, specification requ ments were temporarily relaxed make it easier for new contract to manufacture military items. Te nical and production personnel of DPSC clothing factory furnished vice and assistance to contractors the fabrication of new uniform ite

In all three commodity areas ma aged by DPSC, military deman created a need for substantial dustry orientation to effectively tra mit these demands to contractors a to lay before them programmed p curements as far distant into the ture as could adequately be forec Through constant conferences w the heads of clothing, food and me cal materiel manufacturers, the ce

(continued on page 22)

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Gilbert W. Fitzhugh, who has held the position of Chairman of the Board and Chief Executive Officer of Metropolitan Life Insurance Co. since 1966, has been appointed Chairman of a Blue Ribbon Panel to study the organization of the Defense Department, its research and development programs, and its procurement practices. Secretary of Defense Laird has said he expects this panel to conduct the most comprehensive review of DOD since the Hoover Commission studies of 1947 and 1953.

Robert J. Pranger is the new Dep. Asst. Secretary of Defense for Near East and South Asian Affairs, Office of the Asst. Secretary of Defense (International Security Affairs).

Paul Wollstadt has been named Dep. Asst. Secretary of Defense (Manpower and Reserve Affairs) for Manpower Research and Utilization.

Yuan-Li Wu has been sworn in as Dep. Asst. Secretary of Defense for Policy Planning and Arms Control, Office of the Asst. Secretary of Defense for International Security Affairs.

David M. F. Lambert has assumed the duties of Dir., Small Business and Economic Utilization, in the Office of the Asst. Secretary of Defense (Installations and Logistics).

RAdm. John P. Sager, USN, has been named Exec. Dir., Technical and Logistics Services, Defense Supply Agency, Alexandria, Va.

RAdm. Donald M. White, USN, is the new Dep. Dir. for Inspection Services, Office of Asst. Secretary of Defense (Administration).

Brig. Gen. Chester J. Butcher, USAF, has been named Chief, Requirements and Development Division Office of the Joint Chiefs of Staff. **Col. William J. Evans, USAF,** (brig. gen. selectee) replaces Brig. Gen. Butcher as Dep. Dir. for Concepts and Operational Readiness, Defense Communications Planning Group.

Brig. Gen. Theodore S. Coberly, USAF, has been assigned as Commander, Defense Contract Administration Services Region, Defense Supply Agency, Los Angeles, Calif.

Brig. Gen. Vernon R. Turner, USAF, has replaced **Brig. Gen. Robert J. Meyer, USAF,** as Dir., Aircraft and Missiles Office, Office of the Asst. Secretary of Defense (Installations and Logistics). Brig. Gen. Meyer has retired.

Col. James R. Pugh Jr., USAF, (brig. gen. selectee), is the new Exec. Dir., Procurement and Production, Defense Supply Agency, Alexandria, Va.

Col. Elmer D. Howk, USAF, has been named as Dep. Commander, Defense Logistics Service Center, Defense Supply Agency, Battle Creek, Mich.

DEPARTMENT OF THE ARMY

Maj. Gen. Andrew P. Rollins Jr. has been confirmed as President, Mississippi River Commission, Vicksburg, Miss. He has also succeeded **Maj. Gen. R. G. MacDonnell** as Div. Engineer, Lower Mississippi Region, Army Corps of Engineers. Maj. Gen. MacDonnell has retired.

Brig. Gen. Mahlon E. Gates is the new Asst. Dep. for Research and Laboratories, Army Materiel Command, Washington, D.C.

Brig. Gen. James G. Kalergis has reported to the Army Materiel Command as Comptroller and Director of Programs.

Dr. L. R. Shaffer has been appointed Asst. Dir., Army Corps of Engineers Construction Engineering Research Laboratory, Champaign-Urbana, Ill.

Col. Ernest H. Davis has assumed the post of Dir. of Concepts and Plans, Army Combat Developments Command, Fort Belvoir, Va.

DEPARTMENT OF THE NAVY

Gen. Lewis W. Walt, USMC, Asst. Commandant of the Marine Corps, received his fourth star in ceremonies in Washington, D.C., June 2.

RAdm. Thomas S. King Jr. has been named as Dep. Commander and Chief of Staff, Military Sea Transport Service, Washington, D.C.

The Navy Department has announced the appointment of **RAdm. Raymond E. Peet** as Dir., Office of Program Affairs, Washington, D.C.

Capt. Cyril T. Faulders Jr. is the new Project Manager for the All-Weather Carrier Landing Systems Project, Naval Material Command, Washington, D.C.

Capt. Edmund B. Mahinske has been chosen as Dir., Naval Electronics Systems Command Center, Atlantic Div., Portsmouth, N.H.

DEPARTMENT OF THE AIR FORCE

Gen. John D. Ryan has succeeded **Gen. John P. McConnell** as Chief of Staff of the Air Force. Gen. McConnell has retired. His successor as Vice Chief of Staff is **Gen. John C. Meyer.**

Gen. Howell M. Estes Jr., Commander, Military Airlift Command, Scott AFB, Ill., retired August 1. His replacement is **Gen. Jack J. Catton,** who was concurrently promoted to the rank of general.

Gen. Seth J. McKee was promoted from lt. gen. and has replaced **Gen. Raymond J. Reeves** as Commander, North American Air Defense Command and Commander, Continental Air Defense Command. Gen. Reeves retired August 1.

Maj. Gen. Joseph R. DeLuca has replaced **Maj. Gen. Frederick E. Morris Jr.** as Commander, Advanced Logistics Systems Center, AFLC, Wright-Patterson AFB, Ohio. Maj. Gen. Morris is now Dir., Data Automation, Office of the Air Force Comptroller, Hq., U.S. Air Force.

Brig. Gen. Leo A. Kiley, Commander, Office of Aerospace Research, Washington, D.C., has retired.

Maj. Gen. Andrew J. Kinney, Commander, Armament Development and Test Center, AFSC, Eglin AFB, Fla., has retired. His successor is **Maj. Gen. Jewell C. Maxwell.**

Maj. Gen. John L. McCoy, Dep. Chief of Staff for Plans, AFLC, Wright-Patterson AFB, Ohio, has retired.

DOD-Industry Reciprocity Advances Composite Materials Technology

Doctor Alan M. Lovelace

Combined efforts of Government and industry have verified the most optimistic predictions for aerospace structural composite materials. Prototype hardware, fabricated under Air Force contract or through independent research and development efforts and currently in-service on an experimental basis, has established technological feasibility and has confirmed that substantial weight savings and performance improvements can be achieved through the use of reinforced composite materials. Equally important, tremendous interest and enthusiasm has been generated in industry, and a truly broad cross section of the aerospace industry is now involved in structural composite development.

The Defense Department structural composite materials program is under the direction of the Air Force Systems Command (AFSC). It is the outgrowth of extensive in-house and contract research, sponsored by AFSC's Air Force Materials Laboratory (AFML), which demonstrated the great potential of boron and graphite fiber reinforced composite materials for aerospace structural applications. This potential is due to strength and stiffness (modulus of elasticity) to density ratios far superior to conventional materials.

The total technology concept applied to the advanced composite materials program requires consideration of many factors, such as materials properties, design concepts, design procedures, stress analysis methods, manufacturing methods, component testing, cost effectiveness, and system compatibility. The AFML objective is to fully acquaint industry with the practical structural utilization of reinforced composite materials; and to design, fabricate and test full-scale, flight-worthy hardware that will conclusively demonstrate the advantages of these materials. Therefore, aerospace structural hardware development was introduced in the beginning stages to provide a real-life focus on both progress and problems. This has resulted in vigorous and early training of the using industry in the structural hardware product form it will eventually market.

Structural composite materials have advanced from the research stage to experimental use, and the actual experience obtained in the design, fabrication and test of composite primary structures has instilled a high degree of engineering confidence. Cost effectiveness and producibility are still areas of concern although considerable progress has been made, particularly in the areas of filament and preimpregnated tape production.

Development of Concept

Concepts involved in high-modulus, high-strength fiber reinforced composites were proposed and documented by AFML in 1958, and were based on boron as well as other materials. Contract development procurement action was initiated in 1959, and a contract for development of continuous boron filament was placed with Texaco, Inc., in 1960. After two to three years of development effort, the cost of boron filament was in the area of $8,000 per pound.

At the time the DOD advanced development program was implemented, in 1965, boron filament had achieved a 70-pound-per-month output capacity at a cost of approximately $1,000 per pound. Further process development efforts resulted in the direct payoff of production type processes for filament with minimum tensile strength of 400,000 psi (average of 460,000 psi), 60 million psi modulus, and good filament diameter control. This development eliminated costly and wasteful filament etching treatment. The processing knowledge established by these efforts stimulated a competitive filament supply situation and, as a result, boron filament is now available at a cost of approximately $250 per pound. This cost reduction is particularly encouraging in view of the low volume of filament produced to date. Primary boron filament producers presently have a total annual capacity of over 5,000 pounds, which can be rapidly escalated to a production level of 50,000 to 100,000 pounds a year.

While the bulk of the harware fab-

Doctor Alan M. Lovelace is Director of the Air Force Materials Laboratory, Wright-Patterson AFB, Ohio. He chaired the Boron Working Group of the Air Force Systems Command Ad Hoc Task Force, and his findings and recommendations provided the basis for the implementation of the DOD structural composite materials program and encouraged independent composite research programs by industrial firms. He holds bachelor, master and doctoral degrees from the University of Florida.

ricated has utilized boron filament, graphite fibers have rapidly come to the fore with the promise of strength/weight/modulus properties competitive with boron filament, and prices competitive or lower than boron filament. Graphite fiber development was initiated by AFML in 1964. An important advantage is that the composite technology employed in boron can be applied to the composite technology utilizing graphite structures.

Graphite fibers have certain advantages over boron, such as lower density, easier plastic composite formability due to the flexibility of the multifilament graphite fiber yarn compared with the monofilament boron, and higher modulus to weight ratio. Disadvantages are anisotropy of the fiber and the requirement for a surface treatment for bonding to matrix resins.

Production Techniques

Development of production techniques for a variety of high-quality specification controlled boron tape material had a tremendous impact on fabrication of advanced composite structures. While considerable emphasis was placed on the development of high-strength/high-modulus fibers and high-temperature/high-strength laminating resins, composite strength depends to a great extent on fiber orientation. Optimum tensile strength and modulus are obtained when the boron fibers are coated uniformly with the resin and are collimated with regulated spacing between fibers. (This is not required for the multifilament graphite yarns and is another advantage of graphite.) Efforts were directed toward developing processing techniques for conversion of reeled filament into high-quality collimated, preimpregnated multifilament tape. The resulting controlled filament orientation and ease of handling of the tape, as compared with the handling of individual filaments, have a direct bearing on composite quality and the ease and reproducibility of the fabrication processes used to arrive at a completed composite end item.

A concerted effort has been made by the Air Force Materials Laboratory to inform industry of the advantages of fiber reinforced composite materials and to encourage independent research. As a direct result of this close association, several independent industrial organizations have acquired equipment, and have improved processes for producing and marketing both filament and tape materials on a commercial basis. Thus, a competitive industrial situation evolved which has greatly reduced filament and tape costs.

The Materials Laboratory, assisted by other organizations of the Air Force Systems Command, such as the Air Force Flight Dynamics Laboratory and the Aeronautical Systems Division's Deputy for Engineering, provided guidance to industry concerning not only efficient material formation processes, but also the technical requirements mandatory for flight-worthy structure. This has been a key factor in the successful progression of the advanced composite demonstration items from laboratory specimens to full-scale filament reinforced composite hardware structural assemblies.

Producibility and reliability are primary considerations in hardware fabrication. First-generation prototype equipment development was pioneered by AFML. Prototype automated skin laying equipment is in existence at organizations such as General Dynamics/Fort Worth, Grumman, Boeing Vertol, McDonnell Douglas, Lockheed/Georgia, etc. This equipment is compatible with numerical control techniques and has the potential for low-cost, lightweight, and high-speed composite fabrication. Additionally, material scrappage rates of 10 percent and under compare favorably with the high scrappage rates involved in metallic structures. Long-range projections indicate that advanced composite aircraft structure will not only be vastly superior in performance, but may also cost less than conventional aluminum aircraft structure.

Hardware development has primarily involved aircraft but activity has been undertaken in the reentry vehicle, aeropropulsion, and helicopter rotor blade structure areas to a varying extent. All of these applications indicate that utilization of advanced composites offer potential for significant performance improvements.

In 1966, the F-111 horizontal stabilizer was selected as a test bed on which to develop and demonstrate the technology. This program culminated in the fall of 1968 with the fabrication of full-scale, flight-worthy structures. This hardware saved 300 pounds (27 percent) over the weight of a current aluminum ship set. The weight savings emanate primarily from the skin area. The aluminum skins weigh 426 pounds, compared with 146 pounds for the boron skins. This reflects a conservative and substituation type design; undoubtedly even further weight reductions can be achieved by conceptual redesign of this type structure.

A major milestone of this program was the fabrication and test of two 5-by-5-foot primary load-bearing midsections of the stabilizer. With the support of the Air Force Flight Dynamics Laboratory, the first section was tested to destruction, which occurred at 89 percent of design ultimate load or 133 percent of operating design stresses. The second section was fatigue tested at Wright-Patterson AFB, Ohio, to four aircraft lifetimes, after which it was static tested to 75 percent of design ultimate. The program to develop the flutter-critical F-111 horizontal stabilizer is highly significant because of the complete materials/design/structure technology it provides.

A wing trailing edge panel was also fabricated for the F-111A. After 100 hours of flight test, no sign of deterioration or damage of this piece of secondary structure was evident. Limited production of the wing trailing edge panels has been initiated and these are being incorporated on F-111A production aircraft. These panels will provide both production cost and schedule information, and an in-depth service test program.

Another limited production program is in progress to develop the left hand in-board leading edge slat of the C-5A. This is representative of both larger and contoured membrane type secondary structures.

Independent Research and Development Efforts

In addition to items being fabricated under Air Force contract, a number of structural composite hardware items have been developed through independent research and development. Flight test items in experimental use include:

- General Dynamics/Fort Worth is flying an F-111 with a lower wing surface airflow deflector door and an aft main landing gear door, using boron epoxy composite skin and full-depth aluminum honeycomb structure. These parts completed a one-ye-- service period, with 80 hours o time, and were left on the a continued service testir

(continued on

Spare Parts Supplier to the Armed Forces

Rear Admiral G. C. Heffner, SC, USN

A hardware store with an average of 20,000 individual sales each calendar day of the year, with a catalog listing approximately 600,000 "nuts and bolts" items, with an inventory valued at over $350 million, and with sales totaling more than $280 million a year—this, in essence, describes the Defense Industrial Supply Center (DISC), located at 700 Robbins Ave., Philadelphia, Pa.

The nuts and bolts in this instance are the items used for normal maintenance, overhaul and repair of military equipment. The DISC catalog of merchandise ranges from rope to nails, chain to electrical wire, and bearings to ferrous metal. Altogether, about 80 percent of the requisitions from our military customers are in the hardware area. Thirty-seven percent of the "sales" are strictly hardware, 24 percent in metals, and 19 percent in wire and cable. In all, the DISC catalog represents 25 percent of the total number of items managed by the Defense Supply Agency (DSA), of which the center is a field activity.

DISC is responsible for managing and purchasing 85 percent of the items in its catalog. The Military Services manage 10 percent, and the remainder is decentralized for local purchase. Item turnover in the system is continuous, and each year the Services transfer more and more items to DSA and DISC. In 1967 alone, there was a net increase of 55,000 items to the list of centrally managed items, and in 1968 the increase was 80,000.

In 1963, DISC first accepted responsibility for providing support to the priority weapon systems of the Military Services. Initially, each Service nominated one weapon system for a test program. The Army nominated the Hawk missile; the Navy, the Polaris; and the Air Force, the Minuteman. Since then the Services have entrusted an additional 20 major weapon systems for DISC support. Among the systems now supported are the UH-1 Iroquois and CH-47 Chinook helicopters, the KC-135 Stratotanker, the B-52 Stratofortress, the F-105 Thunderchief, and the M-16 rifle. A total of 42,680 items have been identified as related to major weapon systems.

Scope of Management

The DISC operation is similar to that of any commercial corporate body. From our capital account, merchandise is bought and then "sold" to the Army, Navy and Air Force—DISC customers. They pay us in dollars. Those dollars are used to buy new merchandise to continue sales. If the merchandise purchased does not sell, markdowns result and dollars are lost from our capital fund. In that respect, as any merchant dealing in profit and loss, we must assure that we buy only items that sell, and do this with a minimum of investment. DISC inventories must be held down, and our effectiveness is compared with other inventory control points.

Competent management of industrial military supplies requires the collection and use of control data in a scope and depth that exceeds most other centrally controlled DSA commodities, reflecting the almost universal application of hardware, fasteners, metals, bearings, and similar items in the industrial realm. In contrast to several other types of material which can be managed efficiently on the basis of personnel strength, equipment, population and operating hours, or definite technical applications, DISC's industrial-type items require a comprehensive analysis of past demands, supplemented by reporting and prompt response to material needs for special maintenance programs and new construction.

Thus, on occasion, if an item is continually being used and the manufacturer is in a continual process of manufacturing the item, then the manufacturer and DISC procurement people get together on a requirements contract. This allows the center to reduce inventories and lead time, and distribution is made directly from the manufacturer's production line to the military customer.

Rear Admiral G. C. Heffner, SC, USN, has been commander of the Defense Industrial Supply Center since August 1967. In previous assignments, he served with the Defense Supply Agency as Inspector General; and was Commanding Officer of the Naval Supply Center, Long Beach, Calif., from 1964 to 1966. Admiral Heffner holds a B.S. degree from the University of Washington, and an M.B.A. degree from the Graduate School of Business, Stanford, Calif.

700 Robbins Ave.
Philadelphia, Pa. 19111
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Editor's Note- Organization charts appearing in the Bulletin are edited by the editorial staff to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizational elements not involved in the DOD-industry relationship have been eliminated because of space limitation.

The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.

COMMANDER
RADM G.C. HEFFNER, SC, USN — 2301

DEPUTY COMMANDER
Col. I.J. Kirshrot, USA — 2302

OFFICE OF COUNSEL
COUNSEL — H. Serebransky — 2739/40

PERSONAL STAFF

SMALL BUSINESS SPECIALIST	S. Charles	2747
TRANS. & TRAFFIC MGMT. OFFICER	W. Ballay	3881
PUBLIC AFFAIRS OFFICER	J. Zecca	2310

OFFICE OF COMPTROLLER
COMPTROLLER — H.K. Hawk — 2308/09

OFFICE OF INSTALLATION SERVICES
DIRECTOR — J.E. Tucker — 2702

OFFICE OF PLANNING AND MANAGEMENT
DIRECTOR — W.J. Kissinger (Acting) — 2300/06

OFFICE OF DATA SYSTEMS
DIRECTOR — K.W. Randolph, Capt., SC, USN — 2783/84

DIRECTORATE OF TECHNICAL OPERATIONS
DIRECTOR — O.Z. Baker, Col, USAF — 2385/87

DIRECTORATE OF SUPPLY OPERATIONS
DIRECTOR — G.O. Fowler, Capt, SC, USN — 2314/16

DIRECTORATE OF PROCUREMENT AND PRODUCTION
DIRECTOR — C.L. Arney, Col, USAF — 2705/06

With an extensive overall lead time for procurement and delivery, it is always a challenge to determine what items and in what quantity they should be stocked at each depot. One way not to run out of stock, of course, is to have plenty of it, but inventories cost. Thus, DISC managers and supply analysts strive to reduce inventories, yet retain sufficient stock to meet urgent military demands.

Computer Automation

However, the center's mission involves more than just simply keeping an inventory of salable items. To meet the needs of the Military Services, DISC must provide a responsive supply effort.

In its supply operation, the center renders bills to about 20,000 customers. The large volume and variety of transactions related to receipt, issue and accountability have required the installation of large-scale, high-speed computer and communication equipment. Also, DISC was recently given the assignment of exploring the feasibility of optical scanning equipment in its computer configuration.

Almost all requisitions from military units are received at DISC electronically. They are separated from other administrative traffic and processed by computers to determine material availability. When a material source is registered the computer flashes a release order to a depot, sends a status notice to the consignee, and adjusts on-hand records.

When material is not available, back orders are automatically recorded by a computer and a notice is printed out for manual review and processing by inventory managers for determination of action required. In all, approximately 80 percent of the decisions as to what to buy, when to buy, how much to buy, where to place the materials, and instructions for release of material from a depot to a military customer are made by the computer.

Automation of the requisition processing and procurement function in DISC achieved a significant reduction of lead time. Many factors make up the salient features of this automation. Inventory reviews and requirements determination accomplished under a mechanized supply/demand review system result in computer recommendations for stock replenishments. Another system receives incoming material requests from customers and provides an output for manual review of requirements which cannot be satisfied from available assets.

These requests are converted to computer processable input and entered into the computer where they are reviewed for accuracy, validity and urgency. A purchase request document is computer printed for delivery to the Directorate of Procurement and Production to start the actual buying process. Purchase requests contain the necessary descriptive/technical data, names of previous suppliers, previous prices paid for the items, as well as the quantities required and the storage location so that procurement can be consummated in a minimum time period.

The data processing and communication facilities enable incoming and outgoing traffic to be processed without requiring conversion of network traffic to typed messages or data card format. High-speed communications, for instance, are used to transmit data between the center and depots handling DISC material concerning requisition processing, as well as to communicate with military customers on such matters as requisition status.

Unlike other DSA centers, DISC does not have an indigenous supply depot. Instead, it uses DSA depots and Navy installations in its distribution pattern. Depots in support of DISC items are located in Columbus, Ohio; Mechanicsburg, Pa.; Memphis, Tenn.; Ogden, Utah; and Tracy, Calif. In addition, the Naval Supply Center in Norfolk, Va., is used for support of all military activities in the Atlantic and Mediterranean theaters of operation, while the Naval Supply Center, Oakland, Calif., is used for the Pacific and Southeast Asian theaters.

For the distribution of metals, DISC uses nine direct supply support points, located at high-volume user sites, such as Naval Shipyards and Naval Supply Centers. This concept provides efficient and economical distribution direct to the user by positioning the heavy bulk metals at the point of ultimate consumption.

Purchasing Methods

DISC buys material in support of its commodity management responsibility on the basis of formal advertising or negotiating. In this regard, a central bidders' mailing list is maintained consisting of more than 2,500 manufacturers and suppliers to contact when in a buy position. The li is subdivided into categories of m terials obtainable from groupings suppliers. It is never static but chang from time to time, with new firn being added and those firms that sho no interest or prove unreliable beir deleted. To be added to the bid lis all a potential contractor needs to is visit or write the Defense Industri Supply Center, 700 Robbins Av Philadelphia, Pa. 19111, and ask be included in a specific commodi area by completing a Bidder's Mailir List Application.

In the procurement process tv methods of purchasing are used: fo mal advertising and negotiation. both methods, maximum competiti is obtained. Formal advertising used for purchases which are expect to exceed $2,500 and the item can adequately described for extensive a free competition. Negotiation is us when formal advertising is not fea ble and one of 17 exceptions authoriz by law are present. These 17 exce tions include, among others, such c cumstances as public exigency, whe time is of paramount importanc classified purchases which should n be publicly disclosed; and purchas under $2,500 which are consummat by use of small purchase procedure

During the last fiscal year, 140,4 procurement awards were made to i dustry by DISC valued at $284 m lion. Awards in labor surplus are totaled $9.5 million, while small bu ness firms received awards amounti to $116.9 million.

Consistent with DOD policy, DIS partially sets aside procurements f award to suppliers in labor surpl areas. These partial labor surpl area set-asides are made when t procurement is severable into two more production runs or reasona lots, and one or more labor surpl area concerns are expected to ha technical competency and producti capacity to produce a severable p tion of the procurement at a reaso able price.

Similarly, DISC sets aside procu ments, either totally or partially, award to small business concerns.

Both the Labor Surplus Area P gram and the Small Business Progr contain features which permit DI to recognize a contractor's efforts hiring and training the hard-core d advantaged. They also allow DISC give first preference in the award a partial labor surplus area set-as to certified-eligible concerns which

ao small business concerns, while cond preference is accorded to certi-,d-eligible concerns which are not nall business concerns.

To become a certified-eligible con-rn, a supplier must apply to the De-rtment of Labor through a local S. Employment Service. The firm ıst be located in or near an area of ncentrated unemployment or under-aployment which has been certified the Department of Labor with re-ect to the employment of disadvan-ged persons residing in such areas, id the firm must agree to perform cause to be performed at least 25 rcent of the contract price in or ar such section.

In keeping with the close relation-ip between DISC and the industries which it deals, the center has been ven the assignment as the coordi-ting activity for industry advisory mmittees in the commodity areas of steners, bearings, hardware, and ectrical wire and cable. These com-ittees are composed of senior indus-ial managers from the industries ncerned, personnel from the Army, avy, Air Force, Marine Corps and SA, along with representatives of e Business and Defense Service Ad-inistration of the Department of mmerce. The committees offer the portunity of direct interchange of formation among the center, in-istry, and the activities which use e products, in an effort to solve any oblems related to procurement, item andardization, or supply.

With high-speed communication id computer capability enhancing most instant flow of information to dustry and to military customers, ISC is set to meet the challenge of oviding the Armed Forces with eir industrial supply needs to keep ilitary equipment combat ready.

Air Force Materials Laboratory

(continued from page 9)

- Grumman Aircraft has flown an -6A Intruder with a boron-epoxy mposite skinned outer wing fence. ie part has accumulated about 10 urs flight time.
- Northrop is flying an F-5 with access door made of boron-epoxy. is part has 24 hours flight time, out 12 percent supersonic. Northrop s also successfully flight tested a ament wound graphite yarn rein-rced epoxy wing tip leading edge ction on the F-5A aircraft.
- North American/Columbus Division is flying an RA-5C with two wing leading edge panels made from boron-epoxy. These specimens have approximately 36 hours flight time.
- Lockheed is flying an L-200 (commercial version of the C-141) with a boron-epoxy curved wing tip panel. It has accumulated 40 hours flight time.

These articles are gathering valuable flight environmental information, such as rain erosion, foreign object damage, etc., and employ a variety of surface coatings. To date, there has been no evidence of degradation in any of the specimens.

Many independent research and development efforts have been stimulated and encouraged by AFML through coordinated planning, continuing technical interchange and guidance, and the provision of gratis filament. The latter item is most important to ensure industry use of the highest quality, reproducible reinforcement supplied to Air Force specifications.

More structural parts development efforts have been accomplished with boron fiber composites than with graphite fibers because boron fibers were available in quantity several years before graphite fibers. However, extensive work is now underway in industry (AFML-sponsored and through independent research and development) on graphite fiber composite structural parts, and progress and results are quite encouraging.

There has been continued growth and interest in composite technology, and a high level of maturity has been achieved in a relatively short development period. Independent research and development efforts have served the very important function of putting industry activity on a learning curve. These efforts have broadened industry experience, increased confidence in the use of advanced composites, and elevated a broad cross section of industry to the current technological level. The technology base has been expanded in areas such as emerging composite materials, fabrication techniques, composite design philosophies, and mechanics of composites.

As with all new technologies, many problems are yet to be solved. These include high confidence complex structural design; conceptual design; fabrication reliability, producibility and inspectability; and cost effectiveness. It is certainly reasonable to anticipate that these problems will diminish as the technological momentum increases. There is absolutely no doubt that continued vigorous development will herald the increasing use of advanced composite structures in the 1970s, and will result in truly significant performance improvements in a broad range of weapon systems.

Gamma-Ray Device Studied To Simulate Bullet Penetration

The Air Force is investigating the use of a gamma-ray device to simulate bullet penetrations into aircraft and equipment. The experiments are being conducted by Cornell Aeronautical Laboratory, Buffalo, N.Y., under the direction of the Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio. George Ducker is the laboratory's project engineer.

Cornell will build and evaluate a gamma-ray device for use in determining if the non-destructive testing method can be used to assess bullet protection provided by aircraft structures and components. The assessment of an aircraft's natural, or indigenous, protection is necessary to provide for correct amounts of and locations for armor.

Currently, the Air Force is using actual gunfire to determine structural integrity. This method, however, usually destroys the test item and is often difficult to evaluate.

Cornell engineers will measure the degree of gamma-ray attenuation provided by structural elements, and try to establish a correlation between ballistic stopping power and attenuation. The gamma-ray device will operate somewhat like an X-ray machine, with an emitting source and detectors. The source would emit a specific number of particles per second, beamed at the area to be tested. Detectors inside the aircraft would record the number of particles per second penetrating the aircraft. The difference between the count of unobstructed and obstructed rays may indicate the degree of bullet protection at that point of the aircraft's structure.

Cornell scientists are also interested in the existence of radioactive or other undesirable side effects produced by the device.

GOVERNMENT PRINTING OFFICE PUBLICATIONS

These publications may be purchased at the prices indicated from:

Superintendent of Documents
Government Printing Office
Washington, D.C. 20402.

Maritime Administration Research and Development Technical Report Index. Index of reports on all research performed by the Office of Research and Development of the Maritime Administration up to June 30, 1968. 1969. 64 p. C 39.227:T22/968. 70¢.

Armed Services Procurement Regulation Manual for Contract Pricing. Guidance on the application of pricing policy to pricing problems, and changes in the regulation implemented in Public Law 87–653, the "Truth in Negotiations" Act. 1969. 252 p. D 1.13/4:1/2. $2.00.

Defense Supply Agency, January 1969, An Introduction. Explains the Defense Supply Agency's mission in providing support to the Military Services, DOD, and Federal agencies. 1969. 42 p. D 7.2D 36/969. 30¢.

Air Force Design Manual, Criteria and Standards for Air Force Construction. Construction criteria and standards for materials used in permanent structures, utilities, and other facilities and services at Air Force installations. 1969, 323 p. D 301. 7:88–15/6. $2.75.

OAR 1968 Progress. Annual Office of Aerospace Research report on some of its more recent research. 1968. 143 p. D 301.69–3:68–0007. $1.75.

DOD Contractors' Safety Manual for Ammunition, Explosives, and Related Dangerous Material. Sets forth practices and standards for DOD contracts involving dangerous materials for insuring continuity of production, safeguarding personnel, and preventing property damage. 1968. D 7.6/4:Am 6. $1.50.

Value Engineering, Handbook H10.8–H, September 1968. The perspective, relationship to other programs and disciplines, contractual aspects, criteria for applying, and training aspects of value engineering. 1968. 74 p. D 7.6/4:V 24/2. $1.00.

DEFENSE PROCUREMENT CIRCULARS

Distribution of Defense Procurement Circulars is made automatically by the U.S. Government Printing Office to subscribers of the Armed Services Procurement Regulation (ASPR).

Defense Procurement Circular No. 69, April 30, 1969. (1) Price Representation for Competitive Procurements. (2) Selection of Offerors for Negotiation and Award. (3) Costs Associated With Employment of Disadvantaged Persons (Hard Core Unemployed). (4) Reduction of Qualifications for "Certified Eligible" Concerns. (5) Contractual Correspondence. (6) Master List of Contractors for Negotiated Overhead Rates and Advance Agreements for IR&D Costs. (7) Contracts for Performance in Vietnam. (8) Small Business Size Standards. (9) Distribution of Procurement Documents. (10) Appendix A Change to ASBCA Charter.

Defense Procurement Circular No. 70, May 29, 1969. (1) Distribution of Procurement Documents, ASPR 20–402. (2) Reimbursement of Costs Incurred by Contractors Due to Plant Shutdowns on March 31, 1969. (3) Defense Contract Audit Agency Responsibilities in Connection with Government Property in Possession of Contractors. (4) Management Control Systems. (5) Revised Cost Principles for Educational Institutions. (6) Postponement of Use of "DOES" Code. (7) Procurement Management Reporting System—Section XXI. (8) Reinstatement of Costs—Notice to the Auditor. (9) Appendix A Changes to ASBCA Rules.

RESEARCH REPORTS

Organizations registered fo[r] service may obtain microfich[e] copies of these documents with[out] charge from:
Defense Documentation Center
Cameron Station
Alexandria, Va. 22314

All organizations may pur[chase] microfiche copies (65¢) o[r] full-size copies ($3) of the docu[ments] (unless otherwise indi[cated]) from:
Clearinghouse for Federal an[d] Scientific Information
Department of Commerce
Springfield, Va. 22151

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Constant Back Pressure Recei[ver] for Ocean Hydraulics. Naval C[ivil] Engineering Laboratory, Port [Hu]eneme, Calif., June 1968, 34 p. O[rder] No. AD–837 792.

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Aeronautical Applications of H[olo]graphic Interferometry. Naval P[ost]graduate School, Monterey, Ca[lif.] Apr. 1969, 42 p. Order [No.] AD–684 786.

Contractor Proposal Evaluation Process Defined by AMC

Victor Garvis

During the past decade the Department of Army has increased its dependency upon the creativity, talent and resources of the industrial community for the development of new, advanced weapon systems for its highly specialized forces. Industry has responded to this urgent requirement and has expanded extensively. As a result, numerous elements of industry depend upon defense weapon systems development contracts for continuing support.

The Army Materiel Command (AMC), in its role of logistics and materiel supplier for the Army, must evaluate these developmental proposals emanating from the industrial community to ensure that they represent the greatest potential in the best interest of national defense. Today, this evaluation process has become known as "proposal evaluation and source selection."

Proposal evaluation and source selection is not a new and unique process. In the past, with limited reliance upon industrial resources, evaluation procedures could be developed and "tailor-made" for each procurement. With increased industrial participation in the design and development phases, a more systematic evaluation process was instituted.

AMC headquarters has developed, with guidance from the Defense Department and Department of the Army, a systematic technique for such a proposal evaluation process. This technique provides assurance to both the Army and the industrial community that proposals are judged with objectivity, competency and integrity.

It includes a scoring and evaluation method which can be described as a structure or process with pyramid capabilities for downward segmentation to successively lower levels to any desired evaluation dimension. Inherent in any pyramid type process is the capability for summarization to each successively higher level. Figure 1 depicts a typical example of an evaluation pyramid.

Evaluation Organization

Top management establishes overall direction and control policies for the proposal evaluation cycle; however, these policies do not guarantee effectiveness in the completion of an evaluation process. The effectiveness of the evaluation process is dependent upon the organizational arrangements within the basic policy framework, and the talent, experience and professional competency of the personnel selected.

The scoring and evaluation procedure is designed with organizational flexibility for:

- Assembling large groups for evaluating extensive detail for major and complex weapon systems or research projects.
- Convening compact groups for short durations for weapon systems or research projects of lesser significance.

In determining the organizational stratification and size, numerous aspects must be considered. Considerations include:

- Anticipated size of the contractor's proposal in response to the request for proposal (RFP).
- Level and complexity of information required from contractors as directed by the RFP.
- Number of evaluation statements assembled to evaluate the meaningful aspects of the proposals.
- Complexity and size of the weapon system, study, or end product.

The basic evaluation organization or board, regardless of size, is structured based upon the textual arrangement and design of the RFP. A chairman and his staff direct the efforts of the organization in the accomplishment of the evaluation tasks. The second level of the evaluation organization is composed of groups compatible with the major sections of the RFP, *e.g.*, technical management and cost areas are logical sections of the RFP, consequently a group could be established for each of these areas (Level 2, Figure 1). Groups are composed of committees. The committees are, as at the second level, identified with smaller segments of the RFP,

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e.g., the technical group can be segmented into a vehicle committee and a propulsion committee, etc. Actual evaluation can be performed by individuals at the committee level, however, subcommittees or sub-subcommittees can be established for more complex systems.

The textual arrangement of the RFP establishes the format for the contractor's proposal and, subsequently, the structural arrangement of the evaluation organization. However, such areas within the RFP, and consequently the proposals, cannot be refined to the extent that overlap is eliminated. For example, certain aspects of management have technical properties and vice versa, such as:

- Analog computer capabilities for engineering design.
- Adequacy of research and development facilities.
- Time, cost and technical performance tradeoffs and impact.

Because of potential overlap between areas, it is advantageous to provide for a degree of talent and experience interchange between areas. For example, some members of the management group could not only be technically oriented, but also possess knowledge of management principles and practices or have experience as operating managers. Individuals with this aptitude and experience, although assigned to the management group, would also provide necessary technical knowledge for complete assessment of other areas with which they have technical capability for analysis.

The success of the proposal evaluation and source selection mission is dependent largely upon the caliber of individuals selected to serve as evaluators; consequently, extreme care is exercised in their selection. Critical factors in their selection are talent; professional accomplishments; specialized, related, or compatible experience; personal integrity and reputation; and ability to exercise good judgment and properly appraise all items of information. After selection, assignment to the evaluation group is a delicate process. It is delicate because individuals with these qualifications are frequently key individuals within their own organizations. As a result, they are frequently selected by name, and the necessary authority is cited to effect the assignment.

Upon convening the evaluation organization, it is imperative that management relieve members of all other tasks other than the evaluation. Individuals, while performing the evaluation tasks, cannot be "plagued" by secondary responsibility or home office problems. Individual performance requires special diligent attention to countless words of information within a critical time frame with no leniency in the toleration for error.

Evaluation Criteria

As shown in Figure 1, the foundation for the scoring and evaluation method is the evaluation criteria. The evaluation criteria divide the RFP into workable-sized units in accordance with the basic outline provided in the RFP. These units are in the form of evaluation statements or questions that channel the proposal review directly to specific items or areas. In the development of the evaluation statements, caution must be exercised to ensure that they relate only to the specific requirements of the RFP. As shown in Figure 1, a typical evaluation statement is "sequential logic of network events" or

EVALUATION PYRAMID

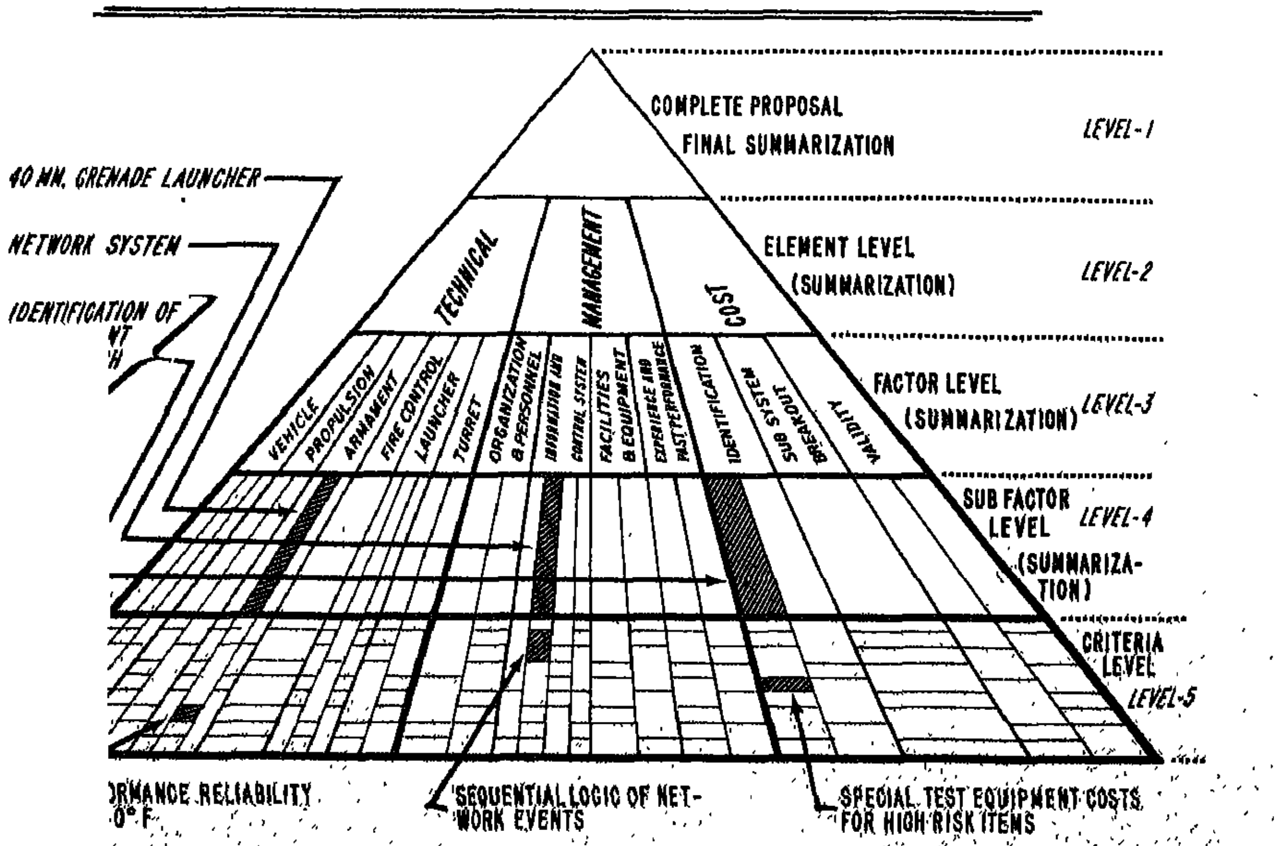

Figure 1.

"special test equipment cost for high risk areas." Any number of evaluation statements can be utilized in the formulation of the evaluation criteria. For example, considerably more statements may be required to assess the weapon system characteristics and potential than would be required to determine the company's management experience and capabilities. The number is dependent upon the impact, emphasis, or complexity of the element, factor, or subfactor.

The evaluation criteria are developed prior to the receipt of the proposals from the contractor. In fact, it is advantageous to develop the evaluation criteria prior to final preparation of the RFP. The development of a criteria at this time serves to "test" the RFP to determine if all requirements are logical and conducive to sound responses from the contractor. Upon the receipt of the proposals from the contractor, the criteria are "locked in" and modifications are not allowed.

Scoring

The evaluation method used includes a scoring system to rate the merit of each proposal. Proposals are reviewed in depth against the statements in the evaluation criteria, and the contractor's response is scored for the degree of excellence related to the evaluation statement. Individual scores produced by the evaluator at this level are classified as "basic" or "raw" scores.

Prior to scoring by individuals, a scoring guide is developed. The purpose of a scoring guide is to unify the evaluator's concepts as to the degree of merit that can be related to each point score.

A typical or sample scoring guide is:

10 **Outstanding:** A comprehensive and extensive response in depth and displaying a very high degree of capability in a respective area.

9 **Superior:** An extensive and detailed response to all requirements and displaying high-level capability in a respective area.

8 **Excellent:** A response with clear definable detailed information for all major positions of requirement, and with a strong capability in excess of the basic requirement.

7 **Very Good:** A response with detailed information and recognized capability in excess of minimum requirements in a respective area.

6 **Good:** A response with limited detail and capability in excess of the minimum requirement in a respective area.

5 **Adequate:** A response complying with the established requirements and with acceptable capability in a respective area.

4 **Weak:** Lack of clarity in a response or vague indications that a capability exists.

3 **Poor:** Omission of minor details —omissions or misunderstandings of requirements in a minor area of capability not defined.

2 **Very Poor:** Omission of major details and facts—omission of major requirements or misunderstandings of major requirements in a respective area.

1 **Inadequate:** Gross omissions or failure to respond to a major requirement.

0 **Nonresponsive:** Failure to submit data in a given area.

Two ranges of scores are normally acceptable: the 0 and 10 range or the 0 to 100 range. The 0 to 10 range is preferable as the excellence of a proposal is difficult to segment to the hundredth degree.

Scoring by evaluators is accomplished on an individual basis, independent of other evaluators assigned to the same criteria. Prior to actual scoring of proposals, there is frequently a necessity for interchange of ideas between evaluators relative to the meaning or intent of the information contained in the proposal. However, once the information exchange is completed the scoring is performed individually and the basic scores submitted are individual scores—not a composite score reached by several committee members. Under *no circumstances* are original basic scores assigned by an evaluator modified by any other individual. Where there are questions concerning the original basic score, it is brought to the attention of the evaluator that assigned the score. If the original evaluator considers that the score was recorded erroneously, *he alone can make the correction.* Each individual score is supported by a narrative justification. The narrative justification outlines the strong points, weak points, and general comments of the proposal relative to the individual evaluation statement. Narrative justifications may vary in length from two to three sentences to several pages.

Weighting

All contractor proposal evaluation techniques, particularly those for

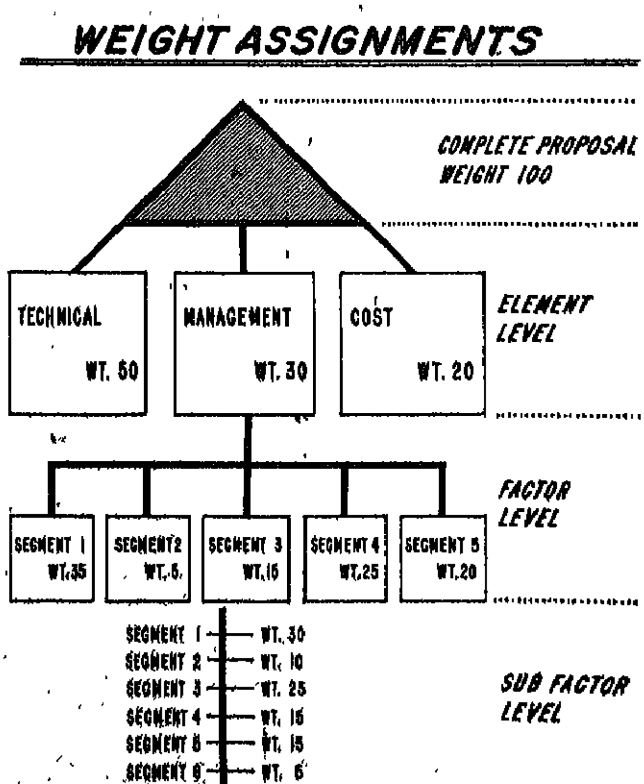

Figure 2.

complex weapon systems, require that increased emphasis be given to priority areas. An integral part of this technique is the capability for providing such increased emphasis, where required. The method for directing this emphasis is through the assignment of weights by percentage distribution to priority areas of emphasis, based upon 100 percent for the complete proposal. Within each of the priority areas, segments can be emphasized or de-emphasized by the same weighting or percentage distribution. Weights can be assigned to all levels of the evaluation pyramid and to all segments at each level with limitations. Figure 2 illustrates such a hypothetical pyramid with sample weights assigned.

Experience has shown that assignment of weights to the individual evaluation statements at the criteria level is of limited value. This is generally the level directly below the subfactor level as illustrated in Figure 2. The weighting of individual evaluation statements increases extensively the arithmetic computation necessary for summarization. An alternate method, at the statement level, for directing the desired emphasis is to increase the number of statements relaive to the areas of importance.

Weight information is not disclosed o the evluation groups until all cores have been assigned and narraive justifications have been completed.

Contractor proposal evaluation and source selection is a difficult process that demands cautious attention to organization and evaluation planning, and tedious and diligent proposal review. The technique employed by AMC has the capability for proposal segmentation to any detail and summarization from any level. It also has ie flexibility for use on small or large ardware systems, of varied descripon and research, or non-hardware tudy efforts.

Army Seeks Safer Fuels

A new dimension in crew survivaility may be added to all Army air, ea and land craft under a requirenent for "safe fuels" proposed by the rmy Combat Developments Comnand (CDC), Fort Belvoir, Va.

Several general approaches are being considered in the program to reduce the threat of fuel fires from crash impact, mines and small arms fire. Laboratory tests have shown the feasability of burning gelled and emulsified fuel in gas turbine engines.

The gelled fuel, with a consistency of gelatin, is made by adding a 2-percent solution of alkylamide to the fuel. In shock of impact, the gelled fuel is scattered in relatively low volatile globules.

Emulsified fuel is made by adding a gelled chemical solution containing approximately 3 percent water to the fuel. On impact, emulsified fuel reverts to a thickened state, reducing the hazard of fire.

A third possibility is visco-elastic additives, which alter or delay initial fuel spurt patterns when the gas tank is punctured or penetrated.

The CDC proposal requires that the fuel must provide for operation without power loss, and must retain ease of handling within a temperature range of -65 to 145 degrees F. The "safe fuel" must also be compatible with current and foreseeable fuel system materials. New techniques will be needed, however, for filtration, tankage, storage, transfer and field delivery.

Army Foresees Electronic Surveying by 1975

Army survey teams of 1975 will use wheels and helicopters instead of feet under a new proposal by the Combat Developments Command (CDC), Fort Belvoir, Va.

The proposal calls for an electronic position and azimuth determining system (PADS) that will provide the three dimensional coordinates, north, east and elevation, plus directional readings. PADS would be adaptable to both standard military trucks and helicopters, consequently eliminating many of the restrictions of present-day line of sight transit and steel tape survey operations.

According to the Army, PADS would have impact on almost every aspect of combat operations. Field artillery would be able to "fire for effect" from a predetermined point without adjusting rounds. Engineer, mobile air defense, infantry maneuver, and inland waterway operations would also profit from PADS' survey control.

PADS is to operate around a north-seeking gyrocompass oriented to earth rotation. It will be unaffected by electromagnetic impulses, including jamming. The gyro will permit initial angle determination using a single reference point.

The CDC proposal calls for accuracy of 10 meters on the grid coordinates, 5 meters on height data, and 1/10 of a mil (about 1/17 of a degree) directionally.

Air Force Art Series Available

A series of 48 full-color lithographs, depicting the U.S. Air Force through photographs and paintings, is available in sets of 12 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. The selections, all 17-by-22 inches, are $2 per set. The sets, order numbers, and subjects are:

Set 1 (D301.76:1): Thunderbirds; Thirsty Phantom; In-Flight Refueling; 200th Minuteman II ICBM Blasts Off; F-100 Super Sabres; U.S. Air Force Academy; T-38 Talon; C-130 Hercules; C-123 Provider; Titan IIIC Booster; F-111A; B-52 Stratofortress.

Set 2 (D301.76:2): Colonel "Mac's" Phantom; Air Support; Over Saigon Harbor; Perimeter Guard; Message For Hanoi; Convoy Cover Highway 19, Vietnam; Ready For Takeoff; Dragonship; Home With The Wounded; Aerovac Nurse; Thunderchief Crew; Mercy Mission.

Set 3 (D301.76:3): C-141 Flying Hospital; Forecast With A Smile; Air Force Sentinels Of Freedom; Ready Now—Air Force Reserve; Aerial Combat Cameraman; C-5 Galaxy—Maiden Flight; C-141 Preflight; Apollo Spacecraft Homeward Bound; Photo of the Month Jan. 68—AAVS; HC-130P—Fulton Recovery System; Skyraiders Escort HC—130P and HH-3E; C-130—Operation Deep Freeze.

Set 4 (D301.76:4): Arctic Radar —Thule BMEWS; Voodoo Launches a Genie; Friendly—B-57 Canberra; F-101 Voodoo; Mission Completed; F-104 Starfighters; ADC Space Trackers; F-104 Starfighter; F-106s Over Mount Ranier; ADC Control Center; Bomarc on Alert; Aerospace Defense Command Pilot.

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Total Compensation Evaluation Goal of DOD Program

Colonel Edward H. Robertson, USAF

incorporate the requirements ɟ review of a contractor's com- ion structure into its assigned ɲn, the Defense Contract Ad- ration Services (DCAS) of fense Supply Agency recently shed a Compensation System (CSR) Program. This pro- is unique. For the first time the Defense Department, an t is being made to evaluate compensation, thereby elimi- piecemeal reviews of the var- ompensation parts. Total com- ion consists of wages/salaries ıcentive compensation (fringe s) as indicated in the Armed s Procurement Regulation), paragraph 15–205.

need for this program grew out erns in the Congress and in the ive Branch over employee com- on paid under government con- In July 1961, President Ken- directed that an interagency of research and development ting practices be undertaken. sulting report to the President vernment Contracting for Re- and Development (commonly as The Bell Report) was ap- on April 30, 1962. It recog- that "there has been a great concern over the salaries and benefits received by personnel ed on federally financed re- and development work in pri- institutions." Particular em- was placed on persons em- in "not-for-profit" establish- doing work exclusively for the ıment.

e that initial study, there have ther reviews of employee com- ion conducted by the Bureau of dget, the ASPR/Contract Ad- ation Panel, and the General ting Office. These studies indi- a need for more uniformity DOD in the review and ap- of employee compensation.

Guideposts Set by Council of Economic Advisers

At this point, it should be stressed that the CSR program is not an attempt to inject a concept of wage controls into DCAS contract administration responsibilities. The only concern is reasonableness of costs to the Government. In its 1968 report to the President, the Council of Economic Advisers stated emphatically that the least desirable method of stabilizing prices was direct controls. Excerpts from this report, contained in the Bureau of National Affairs, Inc., "1968 Briefing Sessions on Collective Bargaining Workbook," enunciate significant concepts. For example, the Council of Economic Advisers stated this overall objective of reasonableness of price:

> The magnitude of the stakes involved in moving promptly toward restoration of reasonable price stability is abundantly clear. It is equally evident that the steps taken to achieve this objective must not impair our other essential goals: maintaining high employment; preserving the effectiveness of free markets in allocating productive resources; and encouraging efficiency and minimizing waste.
>
> The various policies available to improve price stability must be evaluated in the light of these goals.

The council's guideposts, first presented in January 1962, represent a form of income policy for the United States. The guideposts do not merely appeal for general restraint but, in addition, try to provide guidance to individual unions and firms as to the specific behavior of wages and prices which would be consistent with general price stability, as well as with efficient allocation of resources. The 1968 Council of Economic Advisers reviewed the genesis, objectives and principles of the guideposts in detail. In their simplest form, the guideposts rest on three basic propositions as stated in the council's report:

> 1. While changes in wage rates in any particular year reflect special conditions in specific segments of the labor market, they tend to be broadly similar throughout the economy. Existing wage differentials largely reflect a whole set of institutional factors and basic differ-

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ences in skill requirements or other attributes of the job, and it is reasonable that they should change rather slowly.

2. Price changes in any industry or sector are strongly influenced by unit labor costs and also reflect the influence of the value of capital used per unit of output and the prices for materials and services purchased from other industries. *For the economy as a whole, the influence of purchased materials and services essentially cancels out, so that prices depend largely on wages and returns to capital—profits, interest and depreciation.* If prices move in proportion to unit labor costs, the relative shares of wages and returns to capital will remain constant. Moreover, since the capital employed per unit of output shows little trend in most sectors, the rate of return on capital will remain stable. [Emphasis added.]

3. Simple arithmetic requires that, for the average of unit labor costs in the entire economy to be stable, it is necessary that the average change in hourly compensation match, as a percentage, the average change in output per man-hour in the entire economy; and, for the average of prices to be stable, the movements of prices should conform to the movements of unit labor costs.

In defending the first two of these propositions, the Council has frequently asserted not only that they reflect the ways in which wages and prices "ought" to behave, but that they basically reflect the way in which wages and prices tend, in the long run, to behave under free-market conditions.

Other Concerns Pointed to Need for CSR

There were other considerations which motivated implementation of the DCAS total compensation review program. One concern was the ever-increasing compensation costs included in the total price to the Government for purchases of goods and services. Total compensation costs for both the public and private sectors of the national economy are depicted in the 1967 analysis of the Gross National Product (GNP) and the Gross National Expenditure (GNE) by the Department of Commerce. The 1967 GNP was $790 billion, and the GNE for compensation of employees was $468 billion, or almost 60 percent of the GNP. This same analysis identified *total* 1967 National Defense Expenditure for goods and services in the amount of $72 billion. Application of the 60 percent ratio indicates that $43 billion of this total was expended for compensation of employees. Costs of this magnitude require close scrutiny prior to contractual awards.

Another concern is the impact that DOD procurements make on the national economy in the form of contributions to wage spirals as the result of competitions for labor talents. For example, DOD and defense-oriented contractors employ, on a percentage basis, more engineers and scientists than private industry sectors. In 1967, Congress and the President took steps to achieve comparability of salaries between Federal and private employment, a goal set by the Salary Reform Bill of 1962. It appears axiomatic that the private sector will react to government competition for skills by offering additional attractions in the form of increased wages, salaries and/or fringe benefits.

DOD requirements also impact the number of workers employed in the private sector, both directly and indirectly. For example, the September 1967 issue of the "Monthly Labor Review," published by the Bureau of Labor Statistics, U.S. Department of Labor, indicated that 73,000 jobs were supported in FY 1967 for each billion dollars of defense purchases from the private sector. Employment attributable to military expenditures includes both the direct employment necessary to produce the final goods and services purchased, and the indirect employment required in all levels of supporting industries which provide materials, components, transportation, and distribution services ultimately embodied in the final purchase. Indirect employment is further affected by income multiplier or accelerator effects which induce further compensation and investment purchases.

The January 1968 issue of *Business Management* contained an informative article on "Executive Compensation" for 1968, which reinforces the DCAS concept of total compensation. Some pertinent excerpts are cited from this article:

a. Salary alone provided limited insight into what senior management persons earn these days.

b. American business is aware that salary, by itself, is not a true measure of a senior executive's worth, nor appropriate compensation for him. In other words, by adding a bonus and a capital pay program to salary, business shows that it is taking what might be called a total compensation approach to the subject of management pay.

c. Why is the chief executive's salary the correct starting place in evaluating compensation? For these reasons:

(1) The top executive's salary is the yardstick by which all other salaries are set.

(2) If the top salary is not in line, a corporation's other compensation-bonus payments, option payments, pensions, and other forms of compensation may present problems.

(3) If the top salary is lower than it should be, there's a tendency to compress other salaries in the company—an open invitation for competitors to move in and lure key men away with more attractive offers.

(4) If the top man's compensation is too high, a company runs the risk of stockholder and union criticism or unwelcome attentions from Government agencies.

(5) The chief executive's salary also is the most conspicuous and obvious. If it fails to reflect the stated corporate purposes and policies, a credibility gap is created that could damage morale.

Another consideration is DOD's concern that the reasonableness of overhead costs be validated. Ensuring contractor surveillance and control of indirect manpower portions of overhead costs is an important part of the CSR Program, and we plan to inject this consideration into our reviews. We believe evaluaton of contractor surveillance and control of indirect manpower is a logical consideration in the determination of reasonableness of costs produced by the contractor's compensation system.

Approach to Program Establishment

Based on the foregoing, we determined that a systems approach to reviewing a contractor's total compen-

ation (as identified in ASPR 15-205.6) is a necessary and desirable method for determining the acceptability of a contractor's employee compensation program. This conclusion resulted in the establishment of the CSR Program. While all elements of costs are subjects of concern, compensation for personal services is especially important, as it is one of the larger items of costs incurred under government contracts. The ASPR recognizes this importance by assigning to the administrative contracting officer the responsibility for determining that a contractor's total compensation policies, practices, and compensation structure conform with sound business practices, and that compensation costs resulting therefrom meet the test of reasonableness required by ASPR 15-205.6.

To date, a nation-wide CSR pilot test has been completed, the results have been evaluated, and a guide for conducting CSRs has been compiled. This guide will eventually become the CSR Manual. One result of the CSR pilot test was confirmation of the acceptability of utilizing the DCAS technical team concept in performing CSRs. This technique has proven successful in other systems reviews performed by this agency, and is considered a cornerstone in our evaluations of contractor financial systems.

The CSR Program is primarily concerned with the total compensation package of wages and salaries, and incentive compensation (fringe benefits) of contractors with anticipated annual negotiated government sales of $15 million or more. However, the flexibility of the CSR Program also allows for other selective reviews depending on the significance of the compensation costs being charged to the Government. We believe this approach marries the requirement for surveillance with the DOD intent to relax contractor controls, wherever possible. To this end, we have eliminated (except in special instances) the need for approval, on an individual contract basis, of individual annual salaries in excess of $25,000, contractor classification systems, incentive compensation plans, and other plans providing fringe benefits and allowances.

Role of DCAS Regions

Acceptance by DCAS of the compensation system includes acceptance of the foregoing parts of the system. This acceptance continues until the contractor changes his compensation system or technicians of the cognizant DCAS region indicate that improper application of the compensation system is producing unreasonable costs to the Government. This concept of relaxation of controls is also a part of the follow-up portion of the CSR Program. The need and frequency for continued surveillance of a contractor's compensation system is determined on an individual contractor basis, rather than by incorporating a mandatory annual review requirement into the program.

The CSR Program is implemented at the DCAS region level. Administrative contracting officers determine which contractors meet CSR criteria. These criteria apply to:

- Contractors with $15 million or more of anticipated annual government negotiated sales, provided the contractor is not qualified under the provisions of ASPR 3-1000, Contractor's Weighted Average Share in Cost Risk.
- "Not-for-profit" contractors who, generally, will be scientific organizations engaged in scientific research for the benefit of the general public. Patents, copyrights, processes, and formula information resulting from scientific research must be made available to the public. The corporate charters of not-for-profit contractors will normally contain this concept.
- Other reviews as necessary due to unusual extenuating circumstances.

After completion of the initial CSR, the frequency of subsequent reviews or follow-up actions depends on the initial CSR report recommendations, significant changes to a contractor's compensation system, or indications from operating personnel (contract auditor, administrative contracting officer, price analyst, etc.) that the contractor is not conducting his compensation system in keeping with approved policies and procedures.

ASPR 1-406(i) cites the contract administration function of reviewing a contractor's compensation structure. One prerequisite for accepting a contractor's compensation system is the determination that the system will produce reasonable costs under government contracts. This consideration is influenced by the contractor's control and evaluation of his manpower requirements, as well as by the acceptability of his compensation system. Compensation is reasonable to the extent that the total amount paid or accrued is commensurate with compensation paid under the contractor's established policy and conforms generally with compensation paid by other firms of the same size, in the same industry, or in the same geographic area for similar services. A determination should also be made that such compensation is reasonable in relation to the actual personal services required.

The results of CSRs are summarized in reports furnished to cognizant administrative contracting officers and procurement contracting officers who have significant procurement interest in the contract. These officials use the reports as bases for performing checks they deem necessary to make decisions as to the acceptability of compensation costs.

The objective of the CSR approach to reviewing contractor compensation systems is not only to satisfy ASPR requirements. The objective is also to provide an effective management tool which permits DCAS accomplishment of contract administration in an orderly, intelligent manner.

Army Engineers Announce New R&D Office

The Chief of Army Engineers has established a Research and Development Office to provide program management services for all U.S. Army Corps of Engineers research and development missions.

The expanding research and development programs of the Engineers, which now averages over $80 million annually, embraces research in basic constructions, military engineering, topography and geodesy, nuclear power applications, arctic environment, and water resources development.

The new office will have a small staff to provide central managment support for the Engineers' research programs. The staff will also review the research activities of the Corps' field activities and laboratories, recommending new work assignments, workload redistribution, and future facility requirements.

Robert F. Jackson, who named Deputy Chief, is serving as Acting Chief of

Army Avionics

(continued from page 3)

cargo handling, refueling, and ordnance handling. The buildup of charge is due both to triboelectric charging and to the earth's field. Charging rates of a few microamperes and earth field gradients of 100 volts per meter are considered normal. However, charging rates in excess of 100 microamperes in snow and sand-dust environments, and earth field gradients of approximately 5,000 volts per meter in disturbed weather, can result in extremely high potentials (–200,000 to +60,000 volts, by actual measurement) depending upon the aircraft type and the existing environmental conditions. These high static potentials cause uncontrolled corona discharges which, in turn, can cause radio frequency interference (RFI). There also exists the possibility of high instantaneous energy transfer upon contact with ground handling personnel. Investigations and tests of present passive and active electrostatic discharges indicate possible solutions to some of these problems. For example, the application of the wing-mounted trailing edge fixed wing precipitation electricity dischargers, or P-STATS, to rotor blades is a current approach to the problem. Further advancements in the development of other passive and/or active electrostatic dischargers to minimize RFI and personnel safety hazards can provide significant improvements.

Tactical Usage.

Tactical usage of Army helicopters to date, and those anticipated in near-term aircraft systems development programs, emphasize the need for significant improvements in extremely low altitude operations, formation flight, and group landing under IFR conditions. The operational uses impose severe requirements on the pilot, avionics technology, and the systematic integration and use of this technology.

Future avionics systems must stress a reliable, systematic design approach to the man-machine interface [illegible] ght [illegible] centered from its inception, mission oriented, and integrated to a degree commensurate with the then current state of the art and mission requirements. Extensive application of man-in-the-loop simulation will be utilized by the Government during system syntheses, and should be considered by potential prime systems contractors to assure accomplishment of these goals.

Defense Personnel Support Center

(continued from page 6)

ter achieved an effective interchange of knowledge between the seller and user. Annual forecasts, showing projected quarterly increments, were provided industry as early as possible.

Lessons Learned from the Past

The foregoing has reviewed the type of emergency problems that have confronted DPSC and its industrial suppliers in the past. How do we at the center view the future? With cautious optimism is the answer. Many lessons have been learned from the major supply crisis of the Southeast Asia situation.

We realize the need for adequate inventories to preclude "crisis" procurements. Such inventories are essential in all commodities procured by DPSC, especially those which require a procurement lead time of six to nine months.

We have learned that even when adequate production is available, as in the case of food items, an urgent need exists for adequate transportation means, especially in the reefer type of conveyance.

We realize that industry is the main support of the Government in time of crisis. A continuing management goal is to achieve improved coordination and cooperation between DPSC and its industry contractors, and we will welcome suggestions from industry for methods that will forestall the "crisis" problems of the past.

Above all, we have learned that, in any national emergency, the combined dedication of industry and DPSC is vital in keeping our Armed Forces adequately supplied with medical ma[illegible] food and clothing.

Contractor Response to Questionnaires

The Defense Department ha received several inquiries fron contractors concerning a ques tionnaire, prepared by a nev publication, soliciting detailed in formation concerning defense sys tems under research, development or production.

Response to any such question naires is governed by paragrapl 5n of the Industrial Security Manual (ISM) for Safeguarding Classified Information (Attach ment to DD Form 441) which re quires clearance of information pertaining to classified contracts Such clearance is a prudent safe guard against the inadvertent disclosure of information harmful to national defense.

In instances where the provi sions of paragraph 5n of the ISM may be inapplicable, the Depart ment of Defense Industrial Secu rity Regulation counsels as a matter of prudence and sound judgment—"When in doubt, or in need of advice, in the exercise of their discretion in this matter, contractors may seek guidance from their cognizant security office."

DSA Will Procure Electronic Items for All Federal Agencies

The Defense Supply Agen (DSA), Alexandria, Va., is assum responsibility for supply support a procurement of electronic items us by civil agencies of the Federal G ernment in a two-phase transfer. September, responsibility for supp of the civil agencies, and items common use by both civil and milita agencies will have been transfer from the General Services Admin tration to DSA. On March 1, 19 responsibility for non-common ite on a selective basis will be tra f rred.

DSA currently provides all the M itary Services, and some civil agenc on a selected basis, with electro items. Procurement is hand through the Defense Electro Supply Center, Dayton, Ohio.

Congress To Get Progress Reports On Weapons Acquisition

The first of a new series of weapon systems status reports were furnished to the Senate Armed Services Committee by Secretary of Defense Melvin R. Laird on June 20. This was the initial group in a series of classified reports to the Senate Committee, entitled "Selected Acquisition Reports," indicating current estimates for various aspects of the systems, including technical objectives and costs.

The reports are one facet of improved and strengthened procedures instituted by Secretary Laird to monitor and control cost and technical progress of major weapon systems and to keep the House and Senate Armed Services and Appropriations Committees currently informed.

In addition to these reports, which will be reviewed and monitored by the Service Secretaries and the Secretary of Defense, a Defense Systems Acquisition Review Council has been established. Composed of the Director of Defense Research and Engineering, and the Assistant Secretaries of Defense (Installations and Logistics), (Comptroller), and (Systems Analysis), the council will review and make recommendations to the Secretary of Defense on all major weapon systems, including decisions to proceed with system development, contract definition and production.

Through these, and other strengthened procedures, continuing review and control over all major weapon systems will be maintained.

In the initial group of 12 acquisition reports, 9 showed a cost growth from the original program plan for the systems totaling approximately $3.5 billion. The percentage of increase above original cost estimates varied between the systems from less than 1 percent to 194 percent (Figure 1).

The predominant reasons for the cost growth, as stated in the nine reports, are (dollar amounts in billions):

Optimistic original cost estimates $1.4

Unforseen development and production problems 0.8

Escalation of labor and material costs 0.9

Configuration changes to resolve technical difficulties 0.4

Cost Growth for Nine* Weapon Systems

($ millions)

	Date of Original Estimate	Total Cost Growth	Amount Funded Thru FY 1970
Lance	Dec 67	$ 20.0	$ 12.2
CVAN '68	Sept 65	108.4	108.4
DX	Nov 67	644.7	129.0
LHA	Dec 66	380.5	140.0
P3C	Sept 67	4.7	4.7
C5A	Oct 65	1,363.0	248.0
SRAM	Sept 65	318.9	273.9
RF-111	Mar 68	216.2	—
FB-111	Feb 66	407.5	891.2
		$3,467.9	$1,807.4

*Of the initial group of 12 systems on which reports went to the Senate Armed Services Committee no cost growth was identified in Safeguard, CVAN '69 and DXGN

Figure 1.

The original estimates for the systems with cost growth were made from 1965 through 1968. Many of the systems have been in production or research for several years; therefore, a portion of the cost growth totaling approximately $1.3 billion already has been included in approved Defense Department budgets through FY 1969, and in the FY 1970 budget request now under review by the Congress. To the extent of this amount of $1.3 billion, the Congress already has been advised of the cost growth experienced and has previously approved the additional funding required through FY 1969.

Both the systems covered in the first reports and other major systems are currently undergoing further intensive review by the Secretary of Defense. Specific decisions will be made in each instance in which additional funding to cover cost growth might be required. Program adjustments will be made if appropriate, consistent with essential defense needs.

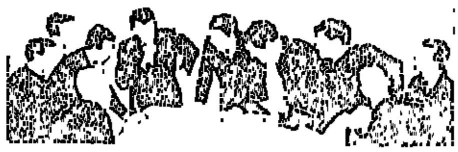
The following is the list of the 31 weapon systems on which the Senate Armed Services Committee had asked for regular reports:

Army: General Sheridan armored reconnaissance tank; Cheyenne armed helicopter; Shillelagh anti-tank missile; Lance missile; Safeguard anti-ballistic missile.

Navy: Attack submarine (SSN-688 class); DX destroyer; Nuclear powered attack carriers (CVAN-68, -69); Landing Helicopter Assault ship (LHA); Nuclear guided missile frigate (DXGN); Poseidon; Phoenix missile; Sparrow missile; Walleye bomb; F-14A fighter; P-3C patrol aircraft; A-7E attack plane; S-3 anti-submarine warfare plane (VSX); MK-48 torpedo; Condor missile.

Air Force: SRAM missile; Maverick missile; Minuteman II and III ICBMs; F-111; C-5A; A-7D; Airborne Warning and Control System (AWACS); AMSA bomber; F-15 fighter; Manned Orbiting Laboratory (MOL).

Additional systems are expected to be included in the new reporting system, reported Secretary Laird.



MEETINGS AND SYMPOSIA

AUGUST

Sixteenth National Armed Forces Management Association Conference, "Technology and Management—The Modern Partnership," August 19-21, Washington Hilton Hotel. Washington, D.C. Sponsor: Armed Forces Management Association. Contact: RAdm. Thomas B. Neblett, USN (Ret.), Armed Forces Management Association, 839 17th St. NW, Washington, D.C. 20006. Phone (202) 659-4500.

Photoelectric and Secondary Electron Emission Conference, August 27–28, University of Minnesota, Minneapolis, Minn. Co-sponsors: Special Devices Group of Advisory Group on Electron Devices, and the University of *Minnesota. Contact: Prof.* W. T. Peria, Electrical Engineering Department, University of Minnesota, Minneapolis, Minn. 55455.

SEPTEMBER

Turbulence Measurements in Liqids Symposium, Sept. 8–9, University of Missouri, Rolla, Mo. Sponsors: U.S. Army Research Office-Durham, Office of Naval Research, Air Force Office of Scientific Research, and the Advanced Research Projects Agency. Contact: James J. Murray, Engineer, U.S. Army Research Office-Durham, Box CM, Duke Station, Durham, S.C. 27706. Phone (919) 286–2285.

Ordered Alloys: Structural Applications and Physical Metallurgy, Sept. 15–17, Lake George, N.Y. Sponsors: Air Force Materials Laboratory and the Metallurgical Society. Contact: Mr. Poynter, Air Force Materials Laboratory, Wright-Patterson AFB, Ohio 45433. Phone (513) 255–3803.

Twenty-fourth Annual National Defense Transportation Association Forum, "Transportation-New Horizons." Sept. 21–24, Regency Hyatt House, Atlanta, Ga. Sponsor: National Defense Transportation Association. Contact: Gerald W. Collins, National Defense Transportation Association, 1612 K St., NW, Washington, D.C. 20006. Phone (202) DIstrict 7–3530.

Annual Air Force Association Fall Meeting and Aerospace Development Briefings, Sept. 22-24, Sheraton-Park Hotel, Washington, D.C. Sponsor: Air Force Association. Contact: Gus Duda, Air Force Association, 1750 Pennsylvania Ave. NW, Washington, D.C. 20006. Phone (202) 298-9123.

Theory and Application of Differential Games International Conference, Sept. 29-Oct. 1, University of Massachusetts, Amherst, Mass. Sponsors: Air Force Office of Scientific Research, American Automatic Control Council, and the Institute of Electrical and Electronics Engineers. Contact: Capt. Allen D. Dayton, Air Force Office of Scientific Research, 1400 Wilson Blvd., Arlington, Va. 2209. Phone (202) OXford 4–5261.

Computers and Communications Conference, Sept. 30-Oct. 2, Rome, N.Y. Sponsor: Mohawk Valley Section, Institute of Electrical and Electronics Engineers. Contact: John M. Harrington, Conference Chairman, 304 E. Chestnut St., Rome, N.Y. 13440. Phone (315) 337–0660.

OCTOBER

Thirteenth Annual Organic Chemistry Conference, Oct. 7–8, Natick, Mass. Sponsor: U.S. Army Natick Laboratories, and the National Academy of Sciences—National Research Council Advisory Board on Military Personnel Supplies. Contact: Dr. L. Long Jr., Head, Organic Chemistry Group, PRL, U.S. Army Natick Laboratories, Natick, Mass. 01760. Phone (617) 653–1000, Ext. 2414.

Annual Association of the United States Army Meeting, Oct. 13–15, Sheraton-Park Hotel, Washington, D.C. Sponsor: Association of the United States Army. Contact: Brig. Gen. Robert F. Cocklin, USAR, Association of the United States Army, 1529 18th St, NW, Washington, D.C. 20036. Phone (202) 483–1800.

Feeding the Military Man Symposium, Oct. 20–22, U.S. Army Natick Laboratories, Natick, Mass. Sponsor: National Academy of Sciences—National Research Council, U.S. Army Natick Laboratories, and Research and Development Associates, Inc. Contact: Executive Secretary, Research and Development Associates, Inc., Natick Laboratories, Natick, Mass. 01760. Phone (617) 653–4920.

Fifteenth Design of Experiments in Army Research, Development and Testing, Oct. 22–24, Redstone Arsenal, Ala. Testing Conference, Oct. 22–24, Redstone Arsenal, Ala. Sponsors: U.S. Army Research Office-Durham, and the Army Mathematics Steering Committee of the Office of the Army Chief of Research and Development. Contact: Dr. Francis G. Dressel, Mathematics Division, U.S. Army Research Office—Durham, Box CM, Duke Station, Durham, S.C. 27706. Phone (919) 286–2285, Ext. 75.

Security Seminar Set for Mid-September

The American Society for Industrial Security will hold its Fifteenth Annual Seminar, "Security, Foundation for a Strong America," September 16–18, at the Washington Hilton Hotel, Washington, D.C.

The seminar program on September 17 will be devoted to presentations by DOD officials. It will be keynoted by Joseph J. Liebling, Director for Security Policy, Office of the Assistant Secretary of Defense (Administration). Panel sessions are also planned on various aspects of the Defense Industrial Security Program, featuring key representatives of the Office of Defense Industrial Security, Defense Supply Agency. The purpose of the day's program is to inform industry of its primary functions in providing adequate protection to classified defense information, consistent with industry's contractual responsibilities.

Further information and registration forms for the seminar may be obtained by contacting William D. Wright Jr., American Society for Industrial Security, 2000 K Street NW, Room 651, Washington, D.C. 20006, Phone (202) 338–7676.

Army Materiel Command Undergoing Reorganization

[Editor's note: The article on the organization and operations of the Army Materiel Commond (AMC), planned for inclusion in the series on the materiel and logistics commands of the Defense Department carried in the past 1969 issues of the *Bulletin*, will be delayed until the realignment of AMC currently in progress is completed. The following item describes the highlights of the AMC reorganization plan.]

The Army Materiel Command began reorganizing its Washington, D.C., headquarters in early June under a realignment designed to streamline the managerial structure.

General Ferdinand J. Chesarek, AMC's commander, stated the purpose of the proposed realignment of the headquarter's organizational structure is to provide better control over assigned missions and functions, reduce the span of control of the commander, and achieve greater utilization of the managerial talent.

A number of important organizational changes are scheduled within the headquarters complex under the reorganization. Directly under the Commanding General is a principal Deputy Commanding General, serving as chief assistant and resource manager. Major General H.A. Miley Jr., a lieutenant general designee, former Assistant Deputy Chief of Staff for Logistics (Program and Budget), has been assigned to that position.

There will also be two new deputy commanding generals. Major General Walter J. Woolwine, former Director of Procurement and Production for AMC, is now Deputy Commanding General for Materiel Acquisition, with the responsibility of control of research and engineering, procurement and production, materiel requirements, logistics data management, and related functions on the industrial base. Major General William N. Redling, former Commanding General of the Army Transportation Center and Fort Eustis, Va., and Commandant of the Army Transportation School, is designated Deputy Commanding General for Logistics Support, with control of operational readiness functions, distribution, transportation, maintenance, international logistics and the AMC depot system, all in support of the Army in the field.

The Deputy for Laboratories, Dr. Robert A. Dillaway, will continue in his job, with a primary interest in the scientific community. He will also direct the activities of the AMC inhouse laboratories.

Three other general officers named for assignment to Headquarters, AMC, are: Major General Leo B. Jones, as Chief of Staff; Brigadier General Theodore Antonelli, as Director of Distribution and Transportation; and Brigadier General James G. Kalergis, as Comptroller.

The directorates and separate offices are also being restructured under the realignment. The 67 project offices are being reduced to 49, with 10 being eliminated as their functions are assumed by the major subordinate commands, and 8 being combined with other project management offices.

The commander's span of control is also being reduced. Instead of 190 commands, agencies, or individuals reporting directly to the AMC Commander, there will be 78. The 60 percent eliminated will be placed under either commodity commanders or the newly designated deputy commanding generals.

There is also a change being made in the structure of project manager offices. Aircraft Weaponization is moving to Headquarters, Army Weapons Command, Rock Island, Ill.; and the Manned Aerial Vehicle for Surveillance office is relocating to Headquarters, Army Aviation Systems Command, St. Louis, Mo.

In instances where systems are well into the production cycle, the project management offices are being eliminated, and a study is under way to determine whether project manager control should be exercised at the commodity command level rather than at the headquarters level.

Project management offices slated to be discontinued include: Flat Top, M113 Italy Co-Production, M107/M110 Artillery, Amphibians and Watercraft, Mortar Ammunition, Multifuel Engines, Rifle, and Goer Vehicles. The Sergeant and Artillery Ammunition offices are also scheduled for disestablishment, pending approval of the Secretary of the Army. Programs scheduled for combining are: Mallard/Random Access Discrete Address, Special Warfare/Special Mission Operations, Manned Aerial Vehicle Surveillance, Mohawk, Uttas/Iroquois, Air Traffic Management/Position and Navigation Systems, Selected Priority Operations/TPQ–28, Air Defense Control and Coordination/Target Missile, and AACOMS/TAS/Teletypewriter/COMSEC.

When completed, the realignment of AMC will:

- Assign to the Deputy Commanding General of AMC the role of resource manager for the command. As such, he will supervise the activities of the Comptroller, the Director of Personnel and Training, and the Director of Installations and Services.
- Elevate the position of the Director of Quality Assurance, in line with a need for top command attention in this area.
- Elevate the position of the Director of Management Information Systems. In his expanded role, he will accelerate the development of automated management systems, and provide key indicators and trends for the Commanding General and other top managers.
- Expand the use of the Army Materiel Systems Analysis Agency, Aberdeen Proving Ground, Md., to accelerate the command's system analysis effort.
- Increase the use of the AMC Board, Aberdeen Proving Ground, for long-range planning in financial management, materiel acquisition, and research and development.

The reorganization of AMC is being accomplished on a phased basis over a period of months.

Status of Funds Quarterly Report

Outlays

Third Quarter, Fiscal Year 1969

(Thousands of Dollars)

Department of Defense	Outlays				Unpaid obligations	
	January 1969	February 1969	March 1969	Cum thru 31 Mar 1969	At start of year	As of 31 Mar 1969
Military Personnel						
Active forces	1,606,522	1,653,112	1,657,909	15,061,173	761,917	904,810
Reserve forces	54,743	57,349	61,315	669,332	149,746	116,264
Retired pay	202,331	210,851	212,536	1,801,651	6,880	7,529
Undistributed	73,606	67,970	—160,629	—168,017	—	168,017
Total—Military Personnel	1,936,202	1,989,282	1,771,131	17,364,139	918,543	1,196,620
Operation and Maintenance	1,695,278	1,771,846	1,837,926	16,008,770	4,033,198	4,331,646
Procurement						
Aircraft	796,437	728,465	808,483	7,029,460	9,591,226	7,905,867
Missiles	201,789	184,833	251,584	1,801,276	2,069,735	2,500,583
Ships	153,809	173,359	167,693	1,410,634	3,447,418	3,208,191
Tracked combat vehicles	38,827	45,289	35,223	337,946	610,190	501,463
Ordnance, vehicles and related equipment	589,797	638,223	612,503	4,543,208	6,595,367	7,173,877
Electronics and communications	125,049	104,320	109,125	1,036,340	1,881,334	1,560,719
Other procurement	188,629	90,467	180,495	1,358,700	2,056,183	1,955,063
Undistributed	—6,557	—15,274	2,553	374,777	—7,225	—393,466
Total—Procurement	2,089,280	1,949,680	2,157,657	17,901,337	26,244,228	24,412,288
Research, Development, Test, & Evaluation						
Military sciences	90,349	70,741	93,070	721,534	777,774	696,728
Aircraft	42,345	56,990	107,217	682,798	717,451	740,990
Missiles	171,485	183,271	187,335	1,692,034	983,018	1,289,142
Astronautics	92,623	85,143	77,645	887,580	487,480	563,365
Ships	32,028	21,175	31,014	234,186	245,279	307,248
Ordnance, vehicles and related equipment	30,128	24,857	29,120	236,718	216,577	263,353
Other equipment	69,874	63,273	69,797	561,744	478,981	486,978
Program-wide management and support	48,722	45,994	51,605	439,246	189,338	225,415
Undistributed	3,940	—11,632	28,785	11,505	—1,633	—13,706
Total—Research, Development, Test, & Evaluation	581,793	539,810	675,591	5,467,346	4,094,265	4,569,512
Military Construction	116,546	103,205	155,125	1,049,740	1,784,255	1,721,361
Family Housing	51,402	48,999	55,570	410,016	174,687	283,668
Civil Defense	5,980	7,941	8,544	66,990	80,629	60,104
Other—Special Foreign Currency Program	36	7	45	803	1,071	678
Revolving and Management Funds	102,391	—176,030	—109,927	—720,925	6,078,411	6,632,424
Subtotal—Military Functions-Federal Funds	6,578,910	6,234,741	6,551,662	57,548,217	43,409,287	43,198,299
Military Assistance—Federal Funds	56,851	14,588	86,952	407,959	1,823,034	1,606,207
Grand Total—Federal Funds	6,635,761	6,249,329	6,638,614	57,955,576	45,232,322	44,804,506
Total—Military Functions-Bud. Concept adj.	—11,410	—7,586	—8,619	—95,984	8,794	3,304
Total—Military Assistance-Bud. Concept adj.	19,270	—7,260	—4,092	150,674	433,454	250,103
Grand Total—Budget Concept adjustments	7,860	—14,846	—12,711	54,690	442,248	253,407
TOTAL—DEPARTMENT OF DEFENSE	6,643,621	6,234,483	6,625,902	58,010,266	45,674,570	45,057,913

Department of the Army

Military Personnel						
Active forces	603,164	664,995	694,651	6,114,416	382,077	428,188
Reserve forces	34,568	34,683	35,608	445,884	112,578	78,677
Undistributed	109,445	84,080	—171,652	—178,183	—	178,183
Total—Military Personnel	747,177	783,758	558,607	6,381,617	494,654	685,048
Operation and Maintenance	549,259	598,862	658,658	5,914,915	1,541,708	1,377,922
Procurement						
Aircraft	83,200	92,182	102,271	836,581	1,343,518	1,031,936
Missiles	55,113	46,719	41,849	402,717	629,712	922,017
Tracked combat vehicles	38,343	44,489	34,212	323,697	586,040	479,139
Ordnance, vehicles, and related equipment	335,023	236,551	244,816	2,060,255	3,445,481	3,717,181
Electronics and communications	50,991	30,804	37,285	340,888	688,774	569,654
Other procurement	54,908	33,787	42,427	373,664	769,510	611,451
Undistributed	—965	—9,541	—22,480	352,600	—7,225	—371,238
Total—Procurement	616,611	474,941	480,379	4,690,351	7,455,810	6,960,143
Research, Development, Test, and Evaluation						
Military sciences	10,255	8,439	7,988	81,724	98,272	102,195
Aircraft	11,752	6,966	8,037	76,012	78,199	89,005
Missiles	43,020	58,255	59,858	480,351	386,866	520,979
Astronautics	544	292	688	6,612	7,865	5,067
Ordnance, vehicles, and related equipment	13,723	15,316	13,690	120,909	110,532	119,107
Other equipment	26,403	27,855	29,623	248,789	196,748	199,768
Program-wide management and support	6,131	5,741	6,425	63,699	83,898	95,763
Undistributed	13,887	—11,756	21,573	42,188	—1,633	—44,386
Total—Research, Development, Test, & Evaluation	125,716	111,049	147,882	1,120,229	910,247	1,027,498
Military Construction	31,798	35,813	82,581	362,975	768,040	688,345
Revolving and Management Funds	—765	—23,560	17,117	—26,100	1,955,905	1,813,564
Army—Federal Funds	2,069,796	1,980,863	1,945,224	18,443,987	13,126,377	12,552,520
Army—Budget Concept adjustments	—4,856	—3,067	—3,142	—47,101	10	—430
TOTAL—DEPARTMENT OF THE ARMY	2,064,940	1,977,796	1,942,031	18,396,885	13,126,387	12,552,091

ɔartment of the Navy

	Outlays				Unpaid obligations	
	January 1969	February 1969	March 1969	Cum thru 31 Mar 1969	At start of year	As of 31 Mar 1969
ary Personnel						
Active forces	495,052	477,093	476,902	4,384,217	225,093	239,388
Reserve forces	10,107	11,374	14,003	110,919	22,898	26,885
Undistributed	–25,400	–1,615	9,969	9,689	—	–9,689
Total—Military Personnel	479,759	486,852	500,874	4,504,825	247,991	256,584
ation and Maintenance	440,659	478,823	485,511	4,118,102	1,466,352	1,675,976
urement						
ircraft	234,427	186,776	251,103	2,085,978	3,218,049	3,041,500
Missiles	33,826	37,019	65,208	374,728	517,934	740,291
hips	153,309	173,359	157,693	1,419,634	3,447,418	3,208,191
racked combat vehicles	484	850	1,011	14,248	21,144	22,314
rdnance, vehicles, and related equipment	124,779	155,477	186,405	1,208,804	1,713,934	1,888,405
lectronics and communications	38,489	46,416	45,382	384,814	645,301	545,985
ther procurement	106,127	–21,222	85,934	600,669	1,143,225	1,228,828
Indistributed	–10,930	816	24,950	31,714	—	–31,778
Total—Procurement	680,512	579,489	817,088	6,120,589	10,740,005	10,643,739
rch, Development, Test, and Evaluation						
ilitary sciences	16,873	17,836	15,191	143,962	121,458	141,180
ircraft	28,369	21,790	20,802	246,507	257,521	318,337
issiles	50,789	52,077	49,810	502,017	258,025	341,351
stronautics	1,703	1,380	2,764	15,361	16,259	17,779
hips	32,028	21,175	31,014	281,186	245,279	307,248
rdnance, vehicles, and related equipment	16,705	9,541	15,490	115,809	106,015	144,240
ther equipment	12,911	10,652	11,717	92,803	79,604	88,585
rogram-wide management and support	14,502	20,335	23,073	169,580	133,064	161,627
ndistributed	–11,230	2,107	4,947	3,212	—	–3,212
Total—Research, Development, Test, & Evaluation	162,600	156,893	174,748	1,523,497	1,217,258	1,520,141
ry Construction	43,808	29,997	22,403	306,386	573,575	651,341
ving and Management Funds	117,426	–19,644	–40,303	–108,177	2,269,078	2,178,669
—Federal Funds	1,924,664	1,712,408	1,960,922	16,495,222	16,514,258	16,929,451
—Budget Concept adjustments	–4,086	–1,997	–2,323	–26,748	110	693
OTAL—DEPARTMENT OF THE NAVY	1,920,578	1,710,411	1,958,599	16,468,474	16,514,368	16,930,143

ɹrtment of the Air Force

ry Personnel						
ctive forces	507,306	511,024	486,356	4,562,540	154,747	237,234
serve forces	10,068	11,292	11,704	113,029	14,270	10,702
ndistributed	–10,439	–14,495	1,054	477	—	–477
Total—Military Personnel	506,935	507,821	499,114	4,676,046	169,017	247,459
ion and Maintenance	602,684	611,306	606,366	5,131,222	927,881	1,178,610
ement						
rcraft	477,810	449,507	455,100	4,106,951	5,029,659	3,832,431
issiles	115,850	101,095	144,527	1,023,831	892,089	838,272
dnance, vehicles, and related equipment	129,639	245,783	181,281	1,271,110	1,434,835	1,568,091
ectronics and communications	35,176	26,424	26,190	304,258	539,008	439,748
her procurement	25,087	75,947	48,701	360,822	100,001	73,690
ndistributed	5,282	–6,529	96	–11,415	—	11,428
Total—Procurement	788,844	892,228	855,912	7,055,064	7,995,592	6,763,666
ch, Development, Test, & Evaluation						
ilitary sciences	17,425	11,075	14,215	118,908	104,162	101,574
rcraft	2,224	28,294	78,878	360,270	381,728	333,048
issiles	77,726	72,930	77,667	709,666	338,627	423,812
tronautics	90,376	83,531	74,193	805,607	463,366	510,519
her equipment	30,560	24,766	28,457	220,142	202,629	198,625
ogram-wide management and support	28,089	19,918	22,107	205,967	22,376	28,025
ndistributed	1,233	–1,984	2,265	–33,890	—	33,892
Total—Research, Development, Test, & Evaluation	247,682	238,478	297,284	2,446,080	1,512,878	1,600,094
y Construction	39,723	36,176	40,023	372,467	425,858	360,331
ing and Management Funds	–6,754	–114,906	–64,479	–115,673	621,170	1,406,071
ce—Federal Funds	2,179,115	2,171,102	2,243,221	19,268,806	11,552,396	11,679,830
ce—Budget Concept adjustments	–2,466	–2,522	–3,152	–22,123	8,675	2,791
TAL—DEPARTMENT OF THE AIR FORCE	2,176,649	2,168,580	2,240,069	19,246,683	11,561,071	11,682,621

Defense Agencies/Office of the Secretary of Defense

Defense Agencies/Office of the Secretary of Defense	Outlays April 1969	Outlays May 1969	Outlays June 1969	Outlays Cum thru 31 Mar 1969	Unpaid obligations At start of year	Unpaid obligations As of 31 Mar 1969
Military Personnel						
Retired Pay	202,391	210,861	212,536	1,801,651	6,880	7,529
Operation and Maintenance	102,776	82,855	87,391	811,531	97,258	99,138
Procurement						
Ordnance, vehicles, and related equipment	356	412	1	3,030	1,117	200
Electronics and communications	393	676	260	6,380	8,251	5,332
Other procurement	2,507	1,955	3,430	24,045	43,447	41,086
Undistributed	56	—20	—13	1,878	—	—1,878
Total—Procurement	3,312	3,023	3,678	35,333	52,815	44,739
Research, Development, Test, & Evaluation						
Military sciences	15,796	33,391	55,676	376,940	453,882	351,779
Military Construction	1,217	1,220	1,118	7,912	16,777	15,344
Family Housing	51,402	48,999	55,570	410,016	174,687	289,668
Other—Special Foreign Currency Program	36	7	45	803	1,071	678
Revolving and Management Funds	—7,515	—17,920	—22,263	—170,975	1,332,258	1,173,520
Defense Agencies—Federal Funds	390,355	362,427	393,751	3,278,212	2,135,628	1,976,393
Defense Agencies—Budget Concept adjustments	—2	—	—1	—11	—	251
TOTAL—DEFENSE AGENCIES/OSD	399,353	362,427	393,750	3,273,201	2,135,628	1,976,644

Office of Civil Defense

Office of Civil Defense	April 1969	May 1969	June 1969	Cum thru 31 Mar 1969	At start of year	As of 31 Mar 1969
Civil Defense	5,980	7,941	8,544	66,990	80,629	60,104
Revolving and Management Funds	—	—	—	—	—	—
TOTAL—OFFICE OF CIVIL DEFENSE-FED. FUNDS	5,980	7,941	8,544	66,990	80,629	60,104

Military Assistance

Military Assistance	April 1969	May 1969	June 1969	Cum thru 31 Mar 1969	At start of year	As of 31 Mar 1969
Military Personnel	38	20	18	198	363	184
Operation and Maintenance	26,709	17,181	24,693	177,523	230,840	264,420
Procurement						
Aircraft	6,521	2,745	16,202	72,464	226,880	199,194
Missiles	640	42	1,785	4,755	16,035	11,046
Ships	2,764	186	8,092	15,548	43,984	80,417
Ordnance, vehicles, and related equipment	13,468	761	23,688	94,355	192,738	166,454
Electronics and communications	4,327	1,186	8,386	43,897	101,235	90,938
Other procurement	4,062	632	5,889	29,082	88,420	83,011
Total—Procurement	31,782	5,552	64,042	260,101	669,292	631,060
Research, Development, Test, & Evaluation	—	—	—	10	35	49
Military Construction	583	—	36	1,554	6,809	4,739
Revolving Fund	—5,900	—2,435	—2,395	—5,036	848,233	700,445
Undistributed	3,640	—5,730	558	—26,991	67,472	5,310
Subtotal—Military Assistance	56,851	14,588	86,952	407,359	1,823,034	1,606,207
Total—Military Assistance-Bud. Concept adjustments	19,270	—7,260	—4,092	150,674	433,454	250,103
TOTAL—MILITARY ASSISTANCE	76,122	7,328	82,860	558,033	2,256,488	1,856,310

Obligations

Department of Defense	Available for Obligation	Obligations January 1969	Obligations February 1969	Obligations March 1969	Obligations Cum thru 31 Mar 1969	Unobligated balance 31 Mar 1969
Military Personnel						
Active forces	19,576,230	1,708,254	1,656,281	1,716,921	15,509,952	4,066,278
Reserve forces	909,786	54,316	64,075	51,797	629,645	280,141
Retired pay	2,275,000	202,278	211,159	212,660	1,801,581	473,419
Total—Military Personnel	22,761,016	1,964,848	1,931,514	1,981,377	17,941,177	4,819,839
Operation and Maintenance	24,026,388	2,572,273	1,589,646	1,750,005	18,007,210	6,019,178
Procurement						
Aircraft	11,513,853	697,272	683,150	530,097	5,684,276	5,829,577
Missiles	4,030,400	171,840	204,358	186,317	2,326,206	1,704,194
Ships	3,685,309	92,087	97,857	129,581	1,240,564	2,444,745
Tracked combat vehicles	478,535	13,710	31,237	49,762	266,136	212,399
Ordnance, vehicles and related equipment	9,636,675	540,515	266,852	314,106	6,634,327	3,002,348
Electronics and communications	2,348,224	77,258	80,500	124,352	838,984	1,509,240
Other procurement	3,036,537	187,092	253,310	146,077	1,658,790	1,377,747
Undistributed	568,026	—	—	—	—	568,026
Total—Procurement	35,297,558	1,780,673	1,567,265	1,480,289	18,649,280	16,648,279
Research, Development, Test, & Evaluation						
Military sciences	1,147,541	90,370	69,388	73,119	708,070	439,471
Aircraft	1,170,871	31,050	109,288	113,111	707,604	463,267
Missiles	2,708,868	115,922	226,624	99,432	2,081,902	626,906
Astronautics	1,286,287	136,378	24,991	130,424	1,019,336	266,951
Ships	468,225	22,416	20,086	15,911	314,673	153,552
Ordnance, vehicles, and related equipment	414,287	27,473	20,391	27,124	285,496	128,791
Other equipment	1,035,598	61,456	48,768	53,165	581,936	453,662
Program-wide management and support	1,106,305	81,544	59,595	113,358	732,349	373,956
Emergency Fund	8,998	—	—	—	—	8,998
Undistributed	59,582	—	—	—	—	59,582
Total—Research, Development, Test, & Evaluation	9,401,563	566,602	579,088	625,642	6,431,427	2,970,135
Military Construction	3,532,935	153,059	96,794	140,014	1,342,633	2,190,301
Family Housing	745,397	116,847	46,446	42,779	527,711	217,686
Civil Defense	69,206	7,198	5,251	5,422	48,474	20,732
Other	15,742	8	2	271	410	15,332
Subtotal—Military Functions	95,849,805	7,161,493	5,816,000	6,025,799	62,948,322	32,901,484
Military Assistance	682,001	102,686	91,986	13,065	343,353	338,648
TOTAL—DEPARTMENT OF DEFENSE	96,531,806	7,264,179	5,907,987	6,038,864	63,291,675	33,240,130

Department of the Army

Department of the Army	Available for Obligation	Obligations				Unobligated balance 31 Mar 1969
		January 1969	February 1969	March 1969	Cum thru 31 Mar 1969	
Military Personnel						
Active forces	8,091,634	701,847	668,952	713,767	6,347,645	1,746,989
Reserve forces	593,600	33,345	34,019	36,048	404,477	189,123
Total—Military Personnel	8,688,234	735,192	702,970	749,816	6,752,122	1,936,112
Operation and Maintenance	9,040,735	837,797	603,417	687,376	6,534,353	2,506,381
Procurement						
Aircraft	1,164,965	31,745	34,642	44,865	542,130	622,835
Missiles	950,516	13,393	39,736	12,978	760,845	189,671
Tracked combat vehicles	449,111	13,377	29,707	48,154	253,718	195,393
Ordnance, vehicles and related equipment	5,491,654	231,670	194,888	107,733	3,837,452	1,654,202
Electronics and communications	870,462	30,582	32,115	30,183	293,801	576,661
Other procurement	602,376	33,052	54,009	14,202	264,676	337,700
Undistributed	380,277	—	—	—	—	380,277
Total—Procurement	9,909,361	353,819	385,097	258,115	5,952,622	3,956,739
Research, Development, Test, & Evaluation						
Military sciences	197,445	14,526	7,649	13,136	132,453	64,992
Aircraft	159,045	5,844	10,132	6,993	87,616	71,429
Missiles	788,390	28,598	108,889	23,393	620,806	167,584
Astronautics	12,194	392	387	628	3,866	8,328
Ordnance, vehicles and related equipment	217,145	10,639	12,735	13,579	131,365	85,780
Other equipment	477,103	37,375	19,353	30,869	256,859	220,244
Program-wide management and support	98,509	6,241	6,046	5,063	68,298	30,211
Undistributed	34,973	—	—	—	—	34,973
Total—Research, Development, Test, & Evaluation	1,984,804	103,615	165,191	93,661	1,301,263	683,541
Military Construction	1,545,523	46,175	28,267	39,142	471,264	1,074,259
TOTAL—DEPARTMENT OF THE ARMY	31,168,657	2,076,598	1,884,042	1,828,110	21,011,624	10,157,033

Department of the Navy

Military Personnel						
Active forces	5,763,804	495,666	479,985	500,586	4,487,938	1,275,866
Reserve forces	156,256	10,754	12,838	13,111	114,858	41,398
Total—Military Personnel	5,920,060	506,420	492,823	513,697	4,602,796	1,317,264
Operation and Maintenance	6,657,705	670,584	441,253	487,229	4,921,747	1,735,958
Procurement						
Aircraft	3,514,905	236,794	366,177	232,520	1,948,742	1,566,163
Missiles	1,000,039	37,484	28,281	68,373	585,057	414,982
Ships	3,685,309	92,987	97,857	129,581	1,240,564	2,444,745
Tracked combat vehicles	29,424	333	1,530	1,608	12,418	17,006
Ordnance, vehicles and related equipment	2,202,943	258,660	37,030	169,151	1,390,386	812,557
Electronics and communications	802,875	25,198	20,118	53,472	294,192	508,683
Other procurement	1,876,817	141,923	130,523	77,886	1,031,041	845,776
Undistributed	—149,156	—	—	—	—	—149,156
Total—Procurement	12,963,155	793,326	681,517	732,591	6,502,400	6,460,755
Research, Development, Test, & Evaluation						
Military sciences	223,221	14,591	13,553	12,703	169,859	53,362
Aircraft	448,396	9,330	80,039	55,684	307,473	140,923
Missiles	789,061	15,131	19,790	34,779	607,437	181,624
Astronautics	25,100	2,042	318	1,123	17,022	8,078
Ships	468,225	22,416	20,086	15,911	314,673	153,552
Ordnance, vehicles and related equipment	197,142	16,834	7,656	13,645	154,131	43,011
Other equipment	141,753	6,812	5,085	7,492	103,790	37,963
Program-wide management and support	723,206	53,556	33,305	88,734	441,347	281,859
Undistributed	235	—	—	—	—	235
Total—Research, Development, Test, & Evaluation	3,016,339	140,721	179,882	229,971	2,115,732	[illegible]
Military Construction	1,309,757	60,217	45,348	57,858	554,830	
TOTAL—DEPARTMENT OF THE NAVY	29,867,017	2,171,268	1,840,772	2,021,346		

Department of the Air Force

Department of the Air Force	Available for Obligation	Obligations January 1969	February 1969	March 1969	Cum thru 31 Mar 1969	Unobligated balance 31 Mar 1969
Military Personnel						
Active forces	5,717,792	510,741	507,344	502,568	1,671,369	1,043,423
Reserve forces	159,930	10,216	17,218	2,638	110,310	49,620
Total—Military Personnel	5,877,722	520,957	524,562	505,206	1,781,679	1,093,043
Operation and Maintenance	7,204,552	964,975	462,368	487,372	5,705,153	1,499,400
Procurement :						
Aircraft	6,833,988	428,733	232,331	252,712	3,193,404	3,604,579
Missiles	2,079,845	121,018	136,311	104,966	980,304	1,099,541
Ships	—	—	—	—	—	—
Ordnance, vehicles and related equipment	1,939,163	49,985	34,912	37,036	1,404,376	534,787
Electronics and communications	664,890	21,261	27,920	40,268	247,530	417,360
Other procurement	459,572	6,716	65,658	51,023	334,017	125,555
Undistributed	311,907	—	—	—	—	311,907
Total—Procurement	12,289,360	627,710	497,157	486,002	6,159,628	6,129,732
Research, Development, Test, & Evaluation						
Military sciences	187,252	15,381	14,185	10,700	127,109	60,143
Aircraft	563,430	15,867	19,117	50,434	312,515	250,915
Missiles	1,131,417	72,193	97,945	41,260	853,719	277,698
Astronautics	1,248,993	133,939	24,286	128,673	998,148	250,545
Other equipment	416,742	17,269	24,930	14,804	221,287	195,455
Program-wide management and support	284,590	21,747	20,244	19,561	222,704	61,886
Undistributed	24,374	—	—	—	—	24,374
Total—Research, Development, Test, & Evaluation	3,856,799	276,395	200,108	265,430	2,735,782	1,121,017
Military Construction	622,961	43,908	22,017	42,293	310,060	312,901
TOTAL—DEPARTMENT OF THE AIR FORCE	29,851,394	2,433,946	1,706,211	1,786,303	19,695,302	10,156,093

Defense Agencies/Office of the Secretary of Defense

Military Personnel						
Retired Pay	2,275,000	202,273	211,159	212,660	1,801,581	473,419
Operation and Maintenance	1,123,396	98,916	82,608	88,028	845,957	277,438
Procurement						
Ordnance, vehicles and related equipment	2,915	200	22	186	2,113	802
Electronics and communications	9,997	217	347	429	3,461	6,536
Other procurement	97,772	5,401	3,125	2,966	29,056	68,716
Undistributed	24,998	—	—	—	—	24,998
Total—Procurement	135,682	5,818	3,494	3,581	34,630	101,052
Research, Development, Test, & Evaluation						
Military sciences	539,623	45,872	33,951	36,580	278,649	260,974
Emergency Fund	3,998	—	—	—	—	3,998
Undistributed	—	—	—	—	—	—
Total—Research, Development, Test, & Evaluation	543,621	45,872	33,951	36,580	278,649	264,972
Military Construction	54,694	2,758	1,164	720	6,479	48,215
Family Housing	745,397	116,847	46,446	42,779	527,711	217,686
Other	15,742	3	2	271	410	15,332
TOTAL—DEFENSE AGENCIES/OSD	4,893,532	472,488	378,823	384,619	3,495,417	1,398,115

Military Assistance

Civil Defense	69,206	7,193	5,251	5,422	48,474	20,732

ffice of Civil Defense

ilitary Personnel	79'	10	—14	5	79	—
peration and Maintenance	552,682	76,176	36,173	7,666	211,730	340,952
rocurement						
Aircraft	38,835	7,254	19,926	2,771	41,433	—2,598
Missiles	—38	276	—575	270	—38	—
Ships	9,048	1,918	3,912	1,411	8,914	134
Ordnance, vehicles and related equipment	49,863	13,633	19,279	111	49,862	1
Electronics and communications	21,182	2,860	9,330	401	21,166	16
Other procurement	10,907	653	4,293	666	10,711	196
Total—Procurement	129,797	26,589	56,105	5,630	132,048	—2,251
Research, Development, Test, & Evaluation	—27	—	—	—	—27	—
Military Construction	—376	—91	—279	—235	—467	91
Undistributed	—155	2	3	—	—8	—147
TOTAL—MILITARY ASSISTANCE	682,001	102,686	91,986	13,065	343,353	338,648

NOTE: All outlay amounts are on a net Treasury basis (gross payments less reimbursement collections), whereas obligations and unpaid obligations are on a gross basis (inclusive of reimbursable activity performed by components of DOD for each other). Therefore, unpaid obligations as of the end of the reporting month cannot be computed from other figures in this report.

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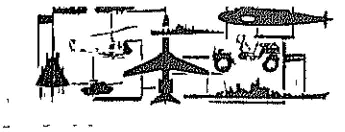

DEFENSE PROCUREMENT

Contracts of $1,000,000 and over warded during the month of June 969.

DEFENSE SUPPLY AGENCY

—**Standard Oil Co. of California**, El Segundo, Calif. $2,017,968. 12,994,000 gallons of kerosene. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-2080.

—**Page Airways, Inc.**, Rochester, N.Y. $1,260,449. Operation and maintenance of Defense Industrial Plant Equipment Facility, Atchison, Kan Defense Industrial Plant Equipment Center, Memphis, Tenn. DSA 002-68-C-0002-P020.

—**Prestex, Inc.**, New York, N.Y. $2,088,725. 2,238,000 yards of wind-resistant poplin rip stop cloth. Spindale, N.C , Thomaston, Ga., and Memphis, Tenn. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2418.

—**Prestex, Inc.**, New York, N.Y. $2,163,071. 2,476,000 yards of cotton cloth. Joanna, S.C., Ninety Six, S.C., Alexander City, Ala., Memphis, Tenn., and Westerly, R.I. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2587.

—**Standard Oil Co. of Calif.**, San Francisco, Calif. $27,341,529. JP-4 jet fuel. El Segundo and Richmond, Calif., Honolulu, Hawaii, El Paso, Tex., East Pasco, Wash., and Kenai, Alaska. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-2053.

—**Eastman Kodak Co.**, Rochester, N.Y. $1,049,017. 43,000 rolls of aerial photographic film. Defense General Supply Center, Richmond, Va. DSA 400-69-C-6540.

—The Defense Personnel Support Center, Philadelphia, Pa., issued the following four contracts for 45 inch width cotton sateen cloth:

Riegel Textile Corp., New York, N Y. $2,572,680. 4,400,000 linear yards Trion, Ga. DSA 100-69-C-2606.

Prestex, Inc., New York, N.Y. $1,216,143. 2,130,000 linear yards. Batesburg, S.C., Dalton, Ga., Opelika, Ala., and Memphis, Tenn. DSA 100-69-C-2607.

West Point Pepperell, Inc., New York, N.Y. $1,429,172. 2,500,000 linear yards. Lindale, Ga., and Opelika, Ala. DSA 100-69-C-2608.

J. P. Stevens and Co., Inc., New York, N.Y. $1,821,300. 3,250,000 linear yards. Piedmont, Anderson and Wallace, S C. DSA 100-69-C-2605.

—**Gulf Oil Corp.**, New York, N.Y. $2,170,800. 21,000,000 gallons of JP-5 jet fuel. DSA 600-69-D-1077. $4,575,100. 40,868,500 gallons of JP-4 jet fuel. DSA 600-69-D-2023. Defense Fuel Supply Center, Alexandria, Va.

—**Humble Oil and Refining Co.**, Houston, Tex. $1,150,650. 350,000 barrels of boiler fuel distillate. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1873.

—**Burlington Industries, Inc.**, Cleveland, Tenn. $1,419,664. 258,099 wool bed blankets. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2675.

—**Galion Iron and Manufacturing Co.**, Galion, Ohio. $2,648,778. Road graders. Defense Construction Supply Center, Columbus, Ohio. DSA 700-69-C-8497.

—**J. P. Stevens and Co., Inc.**, New York, N.Y. $3,360,227. 2,972,000 linear yards (45-inch width) of wind resistant, water repellent cotton sateen and nylon cloth. Piedmont and Wallace, S.C. Defense Personnel Support Center, Philadelphia, Pa DSA 100-69 C-2705.

—**Lion Uniform, Inc.**, Dayton, Ohio. $1,740,060. 42,000 pairs of men's flying coveralls. Williamsburg, Ky. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2702.

—**Kings Point Manufacturing Co., Inc.**, Fayetteville, N C $1,962,662. 42,000 pairs of men's flying coveralls. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69 C-2701.

—**Prestex, Inc.**, New York, N Y. $1,162,380 600,000 yards of ballistic nylon cloth. Shawmut, Ala , and Rhodiss, N.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C-2584.

—**West Point Pepperell Inc.**, New York, N.Y. $1,491,750. 382,000 yards of natural color ballistic nylon cloth and 381,000 yards of olive green color. Shawmut, Ala. Defense Personnel Support Center, Philadelphia, Pa. DSA 100 69 C-2585.

—**Putnam Mills Inc.**, New York, N.Y. $2,132,060. 1,100,000 yards of ballistic nylon cloth. Langdale, Shawmut and Lanette, Ala., Rhodiss, N.C., and Rockville, Conn. Defense Personnel Support Center, Philadelphia, Pa. DSA 100 69-C-2583.

—**Western Fuel Co. of Yakima, Inc.**, Yakima, Wash. $1,420,428. 20,774,800 gallons of fuel oil. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-2249.

—**Humble Oil and Refining Co.**, Houston, Tex. $1,428,140. 1,407,312 quart cans of aircraft lube oil. Defense Fuel Supply Center, Alexandria, Va DSA 600 69 C-2436.

—**Stauffer Chemical Co.**, New York, N.Y. $1,324,510. 1,041,672 quart cans and 1,662 55-gallon drums of synthetic lube oil for aircraft engines. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-C-1722.

16—**Standard Oil Co. of Calif.**, San Francisco, Calif. $1,594,478. Gasoline, fuel oil, and solvents. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1710.

17—**Vitro Minerals Corp.**, Denver, Colo. $1,564,380 241,000 net tons of sub-bituminous coal. Cripple Creek Mine, Suntrana Branch, Alaska. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-C-2335.

—**Usibelli Coal Mine, Inc.**, Usibelli, Alaska. $1,171,700. 170,000 net tons of sub-bituminous coal. Usibelli Mine, Suntrana, Alaska. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-C-2336.

20—**Franklin Clothes, Inc.**, Woodbine, N.J. $2,389,740. Men's tropical polyester and wool coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-69-C 2736.

23—**Standard Oil of Calif., Western Operations, Inc.**, San Francisco, Calif. $2,772,631. 19,435,040 gallons of various petroleum products. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D 2242.

—**Griffin Galbraith Fuel Co.**, Tacoma, Wash. $1,311,542. 10,182,000 gallons of fuel oil and 1,187,600 gallons of diesel fuel. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-C-2230.

24—**Shell Oil Co.**, New York, N.Y. $1,452,676. Aviation fuels. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-1801.

30—The Defense Construction Supply Center, Columbus, Ohio, has awarded the following five contracts:

Inter-Alloys Corp., Bartow, Fla. $1,556,145. 60-ton aluminum highway bridges. DSA 700-69-C-G970.

Jeta Power, Inc., Slontsburg, N.Y. $1,470,150. Generator sets. DSA 700-69-C-H047.

Met-Pro Water Treatment Corp., Lansdale, Pa. $1,165,289. Water purification equipment sets. DSA 700-69-C-H020.

Allis Chalmers Mfg. Co., Milwaukee, Wis. $1,142,580. Motorized graders. DSA 700 69-C-E578.

Jeta Power, Inc., Slontsburg, N.Y. $1,000,743. Generator sets. DSA 700-69-C-H046.

—The Defense General Supply Center, Richmond, Va., awarded the following four contracts:

Pettibone Mulliken Corp., Washington, D.C. $1,614,008. Fork lift trucks. DSA 400 69-C-5415.

Towmotor Corp., Cleveland, Ohio $1,318,275. Fork lift trucks. Mentor, Ohio. DSA 400-69 C-5747.

Otis Elevator Co., Cleveland, Ohio. $1,003,140. Fork lift trucks. DSA 400-69-C 6973.

Otis Elevator Co., Cleveland, Ohio. $1,572,077. Fork lift trucks. DSA 400-69-C 6972.

—The Defense Fuel Supply Center, Alexandria, Va., has awarded the following two contracts for various quantities of fuel oil and gasoline for use at camps, posts and stations in Delaware, the District of Columbia, Indiana, Kentucky, Maryland, Ohio, Tennessee, Virginia and W. Virginia.

BP Oil Corp., Atlanta, Ga. $1,611,600. DSA 600 69-D 2273

American Oil Co., Chicago, Ill. $2,186,319. DSA 600-69-D-2265.

DEPARTMENT OF THE ARMY

3—**Bell Aerospace Corp.**, Fort Worth, Tex. $12,028,000 (contract modification.) Additional UH 1N helicopters and additional funding for the original quantity. Hurst, Tex Army Aviation Systems Command, St. Louis, Mo. DA-AJ01 69 C 0085.

—**Swaney Corp.**, Titusville, Fla. $1,925,035. Modification to launch complex 17, Cape Kennedy, Fla. Army Engineer District, Canaveral, Patrick AFB, Fla. DA-CA18-69 C 0004.

—**Eugene Luhr and Co.**, West Sacramento, Calif. $1,072,770. Construction on both banks of the Sacramento River and Georgiana Slough, Calif. Army Engineer District, Sacramento, Calif. DA CW05 69 C 0070.

4—**Levinson Steel Co.**, Pittsburgh, Pa. $13,883,558. Metal parts for 105mm projectiles. Hayes Army Ammunition Plant, Pittsburgh, Pa. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-C 0023.

—**R. G. LeTourneau, Inc.**, Longview, Tex $2,180,730 (contract modification). Metal parts for 750 pound bombs. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69 C 0044.

—**Forsberg & Gregory Construction Co.**, Redlands, Calif. $1,720,319. Construction of three maintenance docks, Davis-Monthan AFB, Ariz. Army Engineer District, Los Angeles, Calif. DA CA09-69-C 0180.

—**Leon H. Perlin Co., Inc.**, Newport News, Va. $1,070,000. Construction of shop classrooms for helicopter maintenance instruction, Fort Eustis, Va. Army Engineer District, Norfolk, Va. DA-CA65 69-C-0133.

—**Centex Construction Co., Inc.**, Dallas, Tex. $8,244,000. Construction of duplex buildings, Fort Hood, Tex. Army Engineer District, Fort Worth, Tex. DA CA63-69-C 0167.

—**Jeta Power, Inc.**, Sloatsburg, N.Y. $1,228,224. 100 kw, 50-60 cycle generator sets. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-69-C-0281.

—**Litton Systems, Inc.**, Woodland Hills, Calif. $1,100,000 (contract modification). Digital computers, inertial measurement units, precision mounting fixtures, and purge and fill stations. Army Electronics Command, Fort Monmouth, N.J. DA-AB07 68 C 0345.

—**Continental Motors Corp.**, Mobile, Ala. $2,519,700 (contract modification). Rebuild AVDS1790-2A engines for the M60 tank. Army Tank Automotive Command, Warren, Mich. DA-AE07 69-C-1459.

5—**Main Cornice Works**, Beverly Hills, Calif. $1,144,442. Rehabilitation of 13 barracks

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company – Value – Material or Work to be Performed – Location of Work Performed (if other than company plant) — Contracting Agency– Contract Number.

buildings and construction of parking areas, Presidio, San Francisco, Calif. Army Engineer District, Sacramento, Calif. DA-CA05-69-C-0113.

6—Norris Industries, Inc., Los Angeles, Calif. $8,649,907. 105mm cartridge cases. Riverbank, Calif. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0181.

—Amtex Corp., Redwood City, Calif. $1,500,000. Classified research and development. Redwood City and Sunnyvale, Calif. Army Electronics Command, Fort Monmouth, N.J.

—Boeing Co., Seattle, Wash. $1,313,264. Analysis of the Ballistic Missile Defense Alternative Study. Safeguard System Command, Huntsville, Ala. DA-HC60-69-C-0104.

—Melbourne Brothers Construction Co., North Canton, Ohio. $1,175,000. Erect and furnish two pre-fabricated buildings, construct closed ramps and loading docks and miscellaneous work, Ravenna Army Ammunition Plant, Ohio. Army Engineer District, Louisville, Ky. DA-CA27-69-C-0037.

9—Texas Instruments, Inc., Dallas, Tex. $1,500,000 (contract modification). Classified electronic equipment. Army Electronics Command, Fort Monmouth, N.J. DA-AB03-68-C-0425.

—Wisconsin Motor Corp., Milwaukee, Wis. $6,298,912. 10 and 20 horsepower standard military engines. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-67-C-0887.

—Bell Helicopter Co., Fort Worth, Tex. $2,398,617. Rotary wing hubs for UH-1 Huey helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

—Kaman Nuclear Corp., Colorado Springs, Colo. $1,261,898 (contract modification). Acquisition of part two of an EMP study for Safeguard Communications System Test Program. Safeguard Systems Command, Huntsville, Ala. DA-HC60-69-C-0061.

10—General Electric Co., Burlington, Vt. $1,721,250 (contract modification). 20mm automatic guns, M61A1s and GAU-4/As, and SUU-23/A armament pods Army Procurement Agency, New York, N.Y. DA-AF03-69-C-0027.

—Teletype Corp., Skokie, Ill. $1,500,000. Classified electronic equipment. Army Electronics Command, Fort Monmouth, N.J.

—Defense Metal Products Div., Southern Airways Co., Sylacauga, Ala. $7,597,260. Metal parts for 155mm projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0330.

—John Wood Co., St. Paul, Minn. $1,366,753. Fin assemblies for 750-pound bombs, plus crate and suspension lugs. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0424.

—Poloron Products, Inc., New Rochelle, N.Y. $1,302,793. 750-pound bomb fin assemblies with crates and suspension lugs. Scranton, Pa Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0425.

11—Thiokol Chemical Corp., Woodbine, Ga. $1,898,190. 40mm CS cartridges (XM651-E1). Edgewood Arsenal, Md. DA-AA15-69-C-0700.

—L. E. Mason Co., Hyde Park, Mass. $1,181,036 (contract modification). Nose body assemblies for incendiary bomb clusters (M36). Edgewood Arsenal, Md. DA-AA15-69-C-0169.

—Kaiser Jeep Corp., Toledo, Ohio. $1,898,609 (contract modification). 5-ton trucks (M39 series). South Bend, Ind. Project Manager, Army General Purpose Vehicles Office, Warren, Mich. DA-AE06-68-C-0012.

—Winston Ford Co., Inc., Prestonsburg, Ky. $4,266,761. Construction work at Carr Fork Reservoir Project, Ky., near Hazard, Ky. Army Engineer District, Louisville, Ky. DA-CW27-69-C-0076.

12—General Motors Corp., Indianapolis, Ind. $1,883,331. XTG-250-1A transmission assemblies with oil filler kits for M551 Sheridan vehicles. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-3436.

—General Electric Co., Syracuse, N.Y. $9,100,000. Mobile High Power Acquisition Radar (HIPAR) for Nike Hercules Missile System. Army Missile Command, Huntsville, Ala. DA-AM01-68-A-0050.

—Crown Construction Co., Columbus, Ga. $1,016,436. Construction of a two-story operations building with control tower, a hanger extension, a briefing administration building and a radio transmitter building at Fort Rucker, Ala. Army Engineer District, Mobile, Ala. DA-CA01-69-C-0073.

—D. J. Barclay and Co., Inc., Gadsden, Ala. $1,822,875. Construction of an addition to a research and development building, Redstone Arsenal, Ala. Army Engineer District, Mobile, Ala. DA-CA01-69-C-0072.

—List and Clark Construction Co., Overland Park, Kan. $2,132,794. Construction work at the Robert S. Kerr Lock and Dam Project, Arkansas River, near Keota, Okla. Army Engineer District, Tulsa, Okla. DA-CW56-69-C-0133

13—General Motors Corp., Indianapolis, Ind. $2,409,500. Transmission assemblies (XTG-411-2A) for M107 and M110 vehicles. Army Tank Automotive Command, Warren, Mich DA-AE07-69-C-4376.

—Chrysler Motor Corp., Warren, Mich. $1,241,338 (contract modification). 273 one-ton cargo trucks and 49 ambulances Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-0771.

—International Harvester Co., Chicago, Ill. $1,063,572. Seven telephone maintenance and construction trucks, 45 maintenance trucks with platforms, and spare parts kits and technical publications. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4911.

—Litton Systems, Inc., Woodland Hills, Calif. $1,390,700 (contract modification). AN/ASN-86 inertial navigational systems for Mohawk and RU-21 aircraft. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-68-C-0345.

—Fegles Construction and C & I Girdler, Inc., Minneapolis, Minn. $10,400,000 Construction of a munitions plant at the Newport Army Ammunition Plant, Newport, Ind. Army Engineer District, Chicago, Ill. DA-CA23-69-C-0020.

—McElwee and Courbis Construction Co., Inc., Camden, N.J. $1,910,280. Construction work at the Sayers Dam Project, near Blanchard, Pa. Army Engineer District, Baltimore, Md. DA-CW31-69-C-0062.

—AVCO Corp., Stratford, Conn $3,131,015 (contract modification). T-53-L-13A and 701 gas turbine engines. Charleston, S.C., and Stratford. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-C-1874.

—Applied Devices Corp., College Point, N.Y. $1,248,696. Modification kits for the Improved Hawk Simulator, AN/TPQ-29. Army Missile Command, Huntsville, Ala. DA-AH01-69-C-1588.

16—Chrysler Motor Corp., Centerline, Mich. $3,491,073. Various trucks. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4913.

—McGraw Edison, Bristol, Conn. $3,491,060. Mechanical time fuzes for artillery fuzes. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0351.

—Page Communications Engineers, Inc., Washington, D.C. $2,511,385. Transportable microwave terminals for the Southeast Asia Radio Telephone Communications System. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0197.

17—Cook Construction Co., Jackson, Miss. $6,448,535. Replacement of two railroad bridges, and one new span, across the Verdigras River, Wagoner County, Okla. Army Engineer District, Tulsa, Okla. DA-CW56-69-C-0134.

—American Machine and Foundry Co., New York, N.Y. $5,096,000 (contract modification). Metal parts for 750-pound bombs. Garden City, N.Y., and other locations. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0035.

18—Southern Airways of Texas, Inc., Fort Wolters, Tex. $36,188,755. Helicopter pilot training and maintenance of aircraft and related equipment. Army Purchasing and Contracting Office, Fort Wolters, Tex. DA-BD13-69-C-0012.

—Eugene Luhr Co., Sacramento, Calif. $3,528,038. Channel improvement and bridge piers for a future crossing at Alameda Creek, near Fremont, Calif. Army Engineer District, San Francisco, Calif. DA-CW07-69-C-0053.

—Hawthorne Aviation, Fort Rucker, Ala. $2,430,384. Aircraft maintenance of fixed and rotary wing aircraft, and related test support services for the U.S. Army Test Board. Aberdeen Proving Grounds, Md. DA-AD05-69-C-0417.

20—Eastman Kodak Co., Kingsport, Tenn. $6,004,873 (contract modification). Manufacture of various types of explosives. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00035(A).

—Atlas Chemical Industries, Inc., Wilmington, Del. $2,014,058 (contract modification). Production of TNT. Chattanooga, Tenn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00531(A).

—Olin Mathieson Chemical Corp., New York, N.Y $1,561,519 (contract modification). Manufacture of propellants. Baraboo, Wis. Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-AA09-69-C-0014.

—Honeywell, Inc., Hopkins, Minn. $1,234,440 (contract modification). Fuzes for bomblets. New Brighton, Minn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-68-C-0490.

—John Wood Co., St. Paul, Minn. $1,103,807. 750-pound bomb fin assemblies, with crates and suspension lugs Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0424.

—Stone, Marracini and Paterson, and Milton T. Pflueger, San Francisco, Calif. $1,129,000. Preparation of a concept study for the new general hospital, Walter Reed Army Medical Center, Washington, D.C., including models and renderings. Washington, D.C. Army Engineer District, Baltimore, Md. DA-CA31-69-C-0111.

—Glasgow Sand and Construction Co., and Ray Taylor and Rulo Sand and Gravel Co., Glasgow, Mo. $1,029,180. Stabilization of the Missouri River Bank. Army Engineer District, Kansas City, Mo. DA-CW41-69-C-0104.

23—Santa Fe Engineers, Inc., Lancaster, Calif. $2,623,896. Construction of an addition to a hospital at Nellis AFB, Nev. Army Engineer District, Los Angeles, Calif. DA-CA09-69-C-0186.

—Chrysler Corp., Centerline, Mich. $1,347,987. Industrial plant equipment for mobilization planning for medium tank production at the Detroit Tank Arsenal. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4363.

—Bell Helicopter Co., Fort Worth, Tex. $1,076,280. Drive shaft assemblies for UH-1 Huey helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

—Hydromar Corp., Long Beach, Calif. $1,104,300. Dredging at the Channel Harbor entrance, Ventura, Calif. Army Engineer District, Los Angeles, Calif. DA-CW09-69-C-0076.

—Mike Hooks, Inc., Lake Charles, La. $1,830,600. Maintenance dredging along the Calasieu River and Pass Project, Lake Charles, La. Army Engineer District, New Orleans, La. DA-CW69-69-C-0174.

—Thiokol Chemical Corp., Bristol, Pa. $2,161,256 (contract modification). Loading, assembling and packing 105mm cartridges and 4.2mm signal illumination and spotting charges for M565 fuzes. Longhorn Army Ammunition Plant, Marshall, Tex. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00200(A).

—Bucyrus-Erie Co., Evansville, Ind. $3,409,765. 12½-ton crawler mounted crane shovels. Erie, Pa. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-69-C-0302.

—Federal Cartridge Corp., Minneapolis, Minn. $1,680,735 (contract modification). Loading, assembling and packing 5.56mm and 7.62mm cartridges. Twin Cities Army Ammunition Plant, New Brighton, Minn Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-36-038-AMC-01099(A).

—Physics International Co., San Leandro, Calif. $1,735,539 (contract modification). One-quarter-sized Marx generator for a high energy simulator. Defense Atomic Support Agency, Washington, D.C. DA-SA01-68-C-0175.

24—Sylvania Electric Products, Inc., Mountain View, Calif. $1,329,783. Classified items. Central Procurement Activity, Warrenton, Va. DA-HC-69-C-0247.

—Magnavox Co., Fort Wayne, Ind. $5,764,037. AN/GRC-106 radio sets. Philadelphia Procurement Division, Army Electronics Command, Philadelphia, Pa. DA-AB05-67-C-0166.

—Curtiss-Wright Corp., East Paterson, N.J. $3,837,496. Mobile Tactical Imagry Interpretation Facilities (AN/TSQ-43) in expansible vans. Philadelphia Procurement Division, Army Electronics Command, Philadelphia, Pa. DA-AB05-68-C-1233.

—General Electric Co., Utica, N.Y. $1,748,-

480. Chaparral guidance section depot equipment and related documentation and publications for new equipment training. Army Missile Command, Huntsville, Ala. DA-AH01-69-C-1905.

—Bell Helicopter Co, Fort Worth, Tex $1,348,776. Tail rotor gear boxes and transmission assemblies for OH-58A helicopters Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01 68-A-0188.

5—Bell Helicopter Co., Fort Worth, Tex $4,158,000 (contract modification). UH-1H helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-C-0028.

—Hughes Tool Co., Culver City, Calif. $2,247,000. Rotary wing blades for OH-6A helicopters Army Aviation Systems Command, St. Louis, Mo DA-23-204-AMC-03697.

—FMC Corp., San Jose, Calif. $2,717,500 (contract modification). Continued production engineering, inspection, inspection engineering and maintenance analysis in support of the M113A self-propelled vehicle. San Farncisco Procurement Agency, Oakland, Calif DA-04-200-AMC-02929.

—Lear Siegler, Inc., Anaheim, Calif. $3,000,000. Classified electronic equipment. Army Electronics Command, Fort Monmouth, N.J.

—Massachusetts Institute of Technology, Cambridge, Mass. $1,085,500. Computer analysis in Behavioral Sciences. Defense Supply Service, Washington, D.C. DA HC15-69-C-0347.

—IBM Corp., Gaithersburg, Md $1,154,769 [illegible] logistics [illegible] ass., and [illegible] Command, [illegible] Alexan- [illegible]

—Magnavox Co., Urbana, Ill. $2,256,027. AN/GRC-103V radio sets Army Electronics Command, Philadelphia, Pa. DA-AB05-69-C-1332.

—KDI Precision Products, Inc., Cincinnati, Ohio. $1,347,300 (contract modification). Metal parts for 2.75 inch rocket fuzes. Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-AA09-69-C-0196.

—Chamberlain Manufacturing Corp., New Bedford, Mass $5,718,659 (contract modification). Metal parts for 155mm high explosive projectiles (M107). Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69 C-0238.

—LTV Aerospace Corp., Warren, Mich. $2,720,000 (contract modification). Industrial services for the Lance missile system. Army Missile Command, Huntsville, Ala. DA-20-113-AMC-01052.

—Philco-Ford Corp., Newport Beach, Calif. $2,650,000. Extension of FY 1969 engineering services contract for the Shillelagh missile system. Army Missile Command, Huntsville, Ala. DA-AH01-69-C-0084.

—Midvale-Heppenstall Co., Philadelphia, Pa. $1,618,400. Tube forgings for 175mm guns (M113E1). Watervliet Arsenal, Watervliet, N.Y. DA-AF07-69-C-0255.

26—Gibbs Manufacturing and Research Corp., Janesville, Wis. $1,763,200 (contract modification). Fuzes for 2.75 inch rockets. Army Ammunition and Supply Agency, Joliet, Ill DA-AA09-69-C-0104.

—Kaiser Jeep Corp., Toledo, Ohio. $1,025,550. One-ton cargo trucks. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4921.

—General Motors Corp., Detroit, Mich. $1,850,917. 8V71-T diesel engines for M109 self-propelled howitzers. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4896

—General Motors Corp., Indianapolis, Ind. $1,300,495. Breech mechanism assemblies for 152mm gun launchers (M81E1). Watervliet Arsenal, Watervliet, N.Y. DA-AF07-69-C-0362.

—Link Belt Feeder Div., FMC Corp., Cedar Rapids, Iowa. $1,388,280. Self-propelled pile driver hammers Army Mobility Command, St. Louis, Mo. DA-AK01-69-CA630.

—Westinghouse Air Brake Co., Peoria, Ill. $2,468,895 (contract modification). Diesel engined road graders. Indianapolis, Ind. Army Mobility Equipment Command, St. Louis, Mo. DA-23-195-AMC-01083(T).

—United Aircraft Corp., Stratford, Conn. $2,653,700. Design, fabrication, installation and testing of a roller gear transmission system for the S-61 helicopter. Aviation Materiel Laboratory, Fort Eustis, Va. DA-AJ02-69-C-0042.

—Philco-Ford Corp., Philadelphia, Pa. $4,456,791. Engineer, furnish, install, test and make operational, and provide one year's operation and maintenance of a telecommunications system on Taiwan and Okinawa. Army Electronics Command, Fort Monmouth, N.J DA-AB07-69-C-0409

—Stevens Manufacturing Co., Ebensburg, Pa. $2,341,602 (contract modification). Four-wheel semi-trailers DA-AE07-69-C-1443 $1,021,215 (contract modification). 400-gallon water tank trailers DA-AE07-69-C-1461. Army Tank Automotive Command, Warren, Mich.

27—Hamilton Watch Co., Lancaster, Pa. $2,517,000. Mark 15 rear-fitting safety devices for artillery proximity fuzes Harry Diamond Laboratory, Washington, D.C. DA-AG39-68-C-0039.

—Tower Construction, Inc., Honolulu, Hawaii. $1,039,902. Construction of an Air National Guard communications center and automotive maintenance shop, Hickam AFB, Oahu Army Engineer District, Honolulu, Hawaii. DA-CA83-69-C-0026

—Philco-Ford Corp., Newport Beach, Calif. $2,542,964 Chaparral depot ground support equipment and depot maintenance. Newport Beach and Anaheim, Calif. Army Missile Command, Huntsville, Ala. DA-AH01-69-C-1940.

—Continental Motors Corp., Mobile, Ala. $9,018,403 Remanufacture of multi-fuel engine assemblies (LDS465-1). Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-5296.

—Radio Corp. of America, Burlington, Mass. $1,464,750 (contract modification). Research and development effort on Land Combat Support System (LCSS). Army Missile Command, Huntsville, Ala. DA-AH01-69-C-1437.

—Texas Instruments, Inc., Dallas, Tex. $1,315,000. Classified. Mobility Equipment Research and Development Center, Fort Belvoir, Va. DA-AK02-69-C-0603.

—Motorola, Inc., Scottsdale, Ariz. $2,848,125. Special test equipment and ancillary items, drawings and technical publications for AN/APS-94D radar sets. Army Electronics Command, Fort Monmouth, N J DA-AB07-68-C-0419.

—Raytheon Co., Andover, Mass $12,940,552. Line items for Improved Hawk missile ground support equipment. Andover and Waltham, Mass. DA-AH01-69-C-1313. $7,983,000. Tactical telemetry kits and Improved Hawk missile assemblies. DA-AH01-67-C-1312. Army Missile Command, Huntsville, Ala.

—Morrison Knudsen Co., Inc., Seattle, Wash. $11,647,324. Installation of main-line welded rail and secondary line on the Great Northern Railroad. Lincoln County, Mont. Army Engineer District, Seattle, Wash. DA-CW67-69-C-0052.

—Emerson Electric Co., St. Louis, Mo. $1,234,049 (contract modification). Repair parts for the XM28 armament subsystem for 7.62mm machine guns and 40mm grenade launchers. Army Procurement Agency, Chicago, Ill. DA-AF03-69-C-0025.

—General Electric Co., Burlington, Vt. $1,777,334. Armament sub-system for HueyCobra helicopters and Vulcan 20mm automatic guns. Army Procurement Agency, New York, N.Y. DA-AF03-69-C-0004.

—Day and Zimmerman, Inc., Philadelphia, Pa. $3,032,703 (contract modification). Loading, assembling and packing ammunition and related components, Lone Star Army Ammunition Plant, Texarkana, Tex. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00114(A).

—National Gypsum Co., Buffalo, N.Y. $1,360,290 (contract modification). Loading, assembling and packing ammunition, Army Ammunition Plant, Parsons, Kan. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00095(A).

—Olin Mathieson Chemical Corp., New York, N.Y. $1,637,416 (contract modification). Loading, assembling and packing propellants, Army Ammunition Plant, Charlestown, Ind. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0148.

—Chamberlain Manufacturing Corp., Waterloo, Iowa. $1,590,243. Metal parts for 105mm smoke projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0383.

—Gentex Corp., Carbondale, Pa. $2,047,473. SPH/4 helmets. Army Procurement Agency, New York, N.Y. DA-AG25-69-C-0881.

30—General Motors Corp., Detroit, Mich. $9,197,235. Metal parts for 105mm projectiles. Army Ammunition Plant, St. Louis, Mo. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0108.

—Kisco Co., Inc., St Louis, Mo $5,937,750. Metal parts for 105mm cartridge cases. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0043.

—E. I. DuPont de Nemours and Co., Wilmington, Del. TNT. Barksdale, Wis. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0327.

—General Instrument Corp., Chicopee, Mass. $1,011,809. Metal parts for tail fuzes for 750-pound bombs. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0442.

—Bell Aeropace Corp., Fort Worth, Tex. $2,027,391 (contract modification). OH-13S helicopters. DA-AJ01-69-C-0511. $1,437,591. Repair parts and special tools for OH-58A helicopters. DA-AJ01-68-C-1699. Hurst, Tex Army Aviation Systems Command, St Louis, Mo.

—Boeing Co., Morton, Pa. $1,286,139. CH-47C helicopter modification kits. DA-AJ01-68-A-0005 $1,150,708. Shop supplies, tools and modification kits for CH-47 rotor blades. DA-AJ01-68-A-0005. Army Aviation Systems Command, St. Louis, Mo.

—Henry Spen and Co., Inc., Brooklyn, N.Y. $3,432,657. General purpose 4-ton trailers. Army Truck Automotive Command, Warren, Mich. DA-AE07-69-C-5307.

—General Motors Corp., Indianapolis, Ind. $1,100,000. Evaluation, product improvement, fabrication and testing of the automatic loader of the Main Battle Tank (XM70). DA-20-113-AMC-08843(T). $1,000,000. System integration and configuration management for advance production engineering, Main Battle Tank. DA-AE07-69-C-4897. $1,100,000. Long lead time procurement of miscellaneous hardware for the advance production engineering of the Main Battle Tank. DA-AE07-69-C-5272. Work will be done at Warren, Mich., and Milwaukee, Wis. Army Tank Automotive Command, Warren, Mich.

—AMTRON, Inc., Midlothian, Ill. $5,890,000. Switchboards (SB-3082/GT). Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0028.

—Honeywell, Inc., Tampa, Fla. $2,000,000. Classified. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0412.

—Collins Radio Co., Cedar Rapids, Iowa. $1,666,682. Direction finder sets (ARN-83), radio receivers (R-1391/ARN-83), controls and mountings. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0387.

—J. I. Case Co., Racine, Wis. $3,157,961. Scoop loaders. Terre Haute, Ind., Racine, Wis., and Burlington, Iowa. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-69-C-A817.

—Davey Compressor Co., Kent, Ohio. $1,096,615. Trailer mounted compressors. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-69-C-A835.

—Allis Chalmers Manufacturing Co., West Allis, Wis. $1,194,305. Fork lift trucks. Harvey, Ill. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-69-C-A805.

—Litton Systems, Inc., Van Nuys, Calif. $3,374,400. Data converter coordinated air defense systems. Van Nuys and Salt Lake City, Utah. Army Missile Command, Huntsville, Ala. DA-AH01-69-C-0025.

—General Dynamics, Pomona, Calif. $2,252,686. Advanced sensor development (research and development). DA-AH01-69-C-1920. $1,900,000. Development of an advanced passive-optical seeker in support of the advance development phase of the advanced forward area air defense system. DA-AB01-69-C-1944. Army Missile Command, Huntsville, Ala.

—Raytheon Co., Norwood, Mass. $4,407,347. Multiplexers with running spares. North Dighton, Mass. Army Procurement Agency, New York, N.Y. DA-AB05-69-C-1012.

—Ovitron Corp., Newburgh, N.Y. $3,355,526. AN/PRC-25 radio sets and RT-505/PRC-25 receiver transmitters. Army Electronics Command, Philadelphia, Pa. DA-AB05-69-C-1334.

—Continental Heller Corp., Sacramento, Calif. $3,068,000. Construction of warehouses, support offices, a storm reservoir and storm drains, relocation of the railroad, and miscellaneous work, Defense Depot, Tracy, Calif. Army Engineer District, Sacramento, Calif. DA-CA05-69-C-0130.

—H. L. Bishop, Inc., Westhampton Beach, N.Y. Construction of four groins and

placement of dredged sand fill, near Westhampton Beach, in connection with the Fire Island Inlet to Montauk Point Beach Erosion and Hurricane Project, N.Y. Army Engineer District, New York, N.Y. DA-CW51-69-C-0028.

—**List and Clark Construction Co.**, Overland Park, Kan. $2,316,524. Construction of a levee embankment in connection with the Chariton River Flood Control Project, Mo. Army Engineer District, Kansas City, Mo. DA-AK02-69-C-0603.

—**McMath-Trussell Construction Co.**, Columbus, Ga. $1,592,617. Improvement on post road, Fort Benning, Ga. Army Engineer District, Savannah, Ga. DA-CA21-69-C-0134

—**Whittmore-Reiman Construction**, Pueblo, Colo., and **Reiman-Wuerth Co.**, Cheyenne, Wyo. $1,456,770. Construction of two bachelor officers quarters, including site work and utilities, Fort Carson, Colo. Army Engineer District, Omaha, Neb. DA-CA45-69-C-0102.

—**Milgo Electronic Corp.**, Miami, Fla. $1,313,335. Instrumentation radar system. Los Angeles Procurement Agency, Pasadena, Calif. DA-AG07-69-C-0871.

—**Western Pacific Dredging Corp.**, Portland, Ore. $1,478,600. Dredging of the Ventura Marina, Ventura, Calif. Army Engineer District, Los Angeles, Calif. DA-CW09-69-C-0083.

—**Texas Instrument, Inc.**, Dallas, Tex. $2,443,150 (contract modification). Classified. Dallas and Sherman, Tex. Research and Development Center, Army Mobility Equipment Command, Fort Belvoir, Va. DA-AK02-69-C-0603.

—**L. A. Barton and Co.**, Hamel, Ill. $1,390,288 Reconstruction and addition to an airfield apron, Blytheville AFB, Ark. Army Engineer District, Fort Worth, Tex. DA-CA63-69-C-0186.

—**White Motor Corp.**, Lansing, Mich. $1,224,221. 2½-ton trucks. Project Manager, General Purpose Vehicles, Michigan Army *Missile Plant, Warren, Mich. DA-AE06-69-C-0003.*

—***General Time Corp.**, La Salle, Ill. $1,292,827.* Mechanical time fuzes for 105mm cartridges. Frankford Arsenal, Philadel*phia, Pa. DA-AA25-69-C-0604.*

—**Charles J. Craig Construction Co.**, Colum*bia, S.C. $1,044,000. Construction of Armed* Forces Entrance and Examination Station with supporting facilities, Fort Jackson, S.C. *Army Engineer District, Savannah,* Ga. DA-CA21-69-C-0131.

—**Tuckman-Barbee Construction, Inc.**, Washington, D.C. $1,713,025. Construction of a two-story medical research facility, Walter Reed Medical Center, Md. Army Engineer District, Baltimore, Md. DA-CA31-69-C-0122.

—**A. Teichert and Sons, Inc.**, Irwindale, Calif. $1,170,370. Construction of a concrete channel for Rose Creek Project, San Diego County, Calif. Army Engineer District, Los Angeles, Calif. CA-CW09-69-C-0080.

—**PRD Electronics, Inc.**, Syosset, N.Y. $1,094,524. Container assemblies and equipment for meteorology calibration of missiles. Westbury, N.Y. Army Procurement Agency, Cincinnati, Ohio. CA-AG31-69-C-0875.

—**E. I. DuPont de Nemours, Inc.**, Wilmington, Del. $4,537,429. Design criteria and production of equipment to provide and operate five TNT production lines, Newport Ammunition Plant, Newport, Ind. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-68-C-0414.

—**Hamilton Watch Co.**, Lancaster, Pa. $1,898,800. Mk 15, Mod O rear fitting safety devices for fuzes. Harry Diamond Laboratory, Washington, D.C. DA-AG39-69-C-0058.

—**Eastman Kodak Co.**, Gates, N.Y. $1,981,050. Mk 15 Mod O rear fitting safety devices for fuzes. Harry Diamond Laboratory, Washington, D.C. DA-AG39-69-C-0059.

—**Raytheon Co.**, Bristol, Tenn. $2,725,580. Artillery ammunition proximity fuzes. Harry Diamond Laboratory, Washington, D.C. DA-AG39-69-C-0060.

—**Fairchild Space and Defense System**, Copiague, N.Y. $1,414,270. Artillery ammunition proximity fuzes. Harry Diamond Laboratory, Washington, D.C. DA-AG39-69-*C-0061.*

—**Gervis B. Webb Co.**, Atlanta, Ga. $1,079,242. Materials handling system and storage modernization system, South Gate, Calif., and Detroit, Mich. Red River Army Depot, Texarkana, Tex. DA-AG47-69-C-0083.

—**Varo, Inc.**, Garland, Tex $1,780,021 Miniaturized night vision sights Army Electronics Command, Fort Monmouth, N J DA-AB07-69-C-0451.

—**Page Aircraft Maintenance, Inc.**, Lawton, Okla. $39,334,623 (contract modification). Continued provision of all organizational, direct and general support maintenance and scheduled inspections of fixed and rotary wing aircraft, Fort Rucker, Ala Army Purchasing and Contracting Division, Fort Rucker, Ala. DA-BC01-69-C-0003.

—**Darco Construction Co.**, College Station, Tex. $1,397,430. Construction along the Martinez Creek, San Antonio, Tex., in connection with the San Antonio Channel Improvement Project. Army Engineer District, Forth Worth, Tex. DA-CW63-69-C-0080.

—**Lockheed Aircraft Co.**, Plainfield, N J. $1,847,853 Line items of repair parts, radar sets and test sets for the Vulcan Air Defense System Army Procurement Agency, New York, N.Y DA-AG25-69-C-0356.

—**Tri-State Roofing Co. of Ohio**, Parkersburg, W. Va. $1,044,100. Replace roofs, roof drains and gutters on five warehouse buildings, Defense Construction Supply Center, Columbus, Ohio. Army Engineer District, Louisville, Ky. DA-CA27-69-C-0055.

—**Construction, Ltd.** Bordentown, N J. $1,498,000. Construction of a basic combat training facility, Fort Dix, N J. Army Engineer District, New York, N Y. DA-CA51-69-C-0153.

—**Litton Systems, Inc.**, Woodland Hills, Calif. $1,946,980 (contract modification). Inertial navigational systems for the Mohawk and U-21 aircraft. Army Electronics Command, Fort Monmouth, N J. DA-AB07-68-C-0345.

—**Westinghouse Electric Corp.**, Pittsburgh, Pa. $1,440,000. Balanced pressure systems and ancillary items. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. DA-AK02-69-C-0666.

—**Ross Aviation, Inc.**, Fort Rucker, Ala. $5,410,805 (contract modification). Rotary instrument training, fixed wing primary training and fixed wing instrument training, Fort Rucker and Fort Stewart, Ga Purchasing and Contracting Officer, Fort Rucker, Ala. DA-BC01-67-C-0173.

—**Hawthorne Aviation Co.**, Fort Sill, Okla. $1,078,417 (contract modification) Nonpersonal services for the performance of maintenance requirements for all aircraft at Fort Sill, and maintenance support for associated equipment, including navigational and avionics equipment, and the ground control system. Field Artillery Center, Fort Sill, Okla. DA-BD05-68-C-0044.

—**Pullman, Inc.**, Chicago, Ill. $7,260,490 (contract modification). Semi-trailer chassis. Freemont, Calif. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-1103.

—**Henry J. Kaiser Co.**, Oakland, Calif. $2,168,500. Modernization and engineering analysis of Munitions Command, GOCO ammunition production plants. Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0788.

—**Demar Construction Co.**, El Paso, Tex. $1,274,280. Construction of a range facility, White Sands Missile Range, N.M. Army Engineer District, Albuquerque, N.M. DA-CA-47-69-C-0117.

—**Kanarr Corp.**, Kingston, Pa. $1,096,290 (contract modification). M79 40mm grenade launchers. Army Weapons Command, Rock Island Arsenal, Ill. DA-AF03-69-C-0084.

—**Computer Sciences Corp.**, Silver Spring, Md. $1,600,000. Automatic data processing *services for the Army Materiel Command.* St. Louis, Mo. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-C-0948.

—**Federal Electric Corp.**, Paramus, N.J. $1,*250,000. Engineer, furnish, install* and make operational an integrated microwave line-of-sight telecommunications system in the Federal Republic of Germany. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-69-C-0464.

—**Martin Marietta Corp.**, Orlando Fla. $1,756,130. Multiplexers and channel cable containers. Ocala, Fla. Army Electronics Command, Philadelphia, Pa. DA-AB05-69-C-1045.

—**General Motors Corp.**, Indianapolis, Ind. $1,501,810. Transmission assemblies for the M107 combat vehicle. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4927

—**Motorola, Inc**, Scottsdale, Ariz. $1,079,655. Research and development for a *feasibility* contract in connection with Terrain Avoidance Radar (TAR) Army Electronics *Command, Fort Monmouth, N.J. DA-*AB07-69-C-0395

—***Pacific Ventures, Inc.**, Seattle,* Wash $1,181,600. Alteration and repair of various buildings, and street and area lighting, *Fort Lewis, Wash Army Engineering Dis*trict, Seattle, Wash DA-CA67-69-C-0039.

—**Magnavox Co**, Fort Wayne, Ind $2,975,884. *AN/GRC-106* vehicle radio sets. Army Electronics Command, Philadelphia, *Pa DA-AB05-67-C-0166*

—**Martin Marietta Corp.**, Orlando, Fla. $1,462,921. Multiplexers and channel cable combiners, *Ocala, Fla* Army Electronics Command, Philadelphia, Pa. DA-AB05-69-C 1045.

—**Electromagnetic Technology Corp.**, Montgomeryville, Pa. $1,170,750. Line items of repair parts for AN/VTS-2 radar sets for the Vulcan Air Defense System. Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C 0678.

—**Honeywell, Inc.**, Tampa, Fla $1,000,000 (contract modification). Classified. Army Electronics Command, Fort Monmouth, N J. DA-AB07-69-C-0412.

—**Sperry Rand Corp.**, New York, N.Y. $28,259,984 (contract modification). Load, assemble and pack various ammunition items. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00080(A)

—**Hercules, Inc.**, Wilmington, Del. $7,389,907. Propellant production at Sunflower Army Ammunition Plant, Lawrence, Kan. DA-11-173-AMC 00042(A). $1,526,256 Propellant production at the Army Ammunition Plant, Radford, Va. DA-11-173-AMC-00037(A). Army Ammunition Procurement and Supply Agency, Joliet, Ill.

—**Olin Mathieson Chemical Corp.**, New York, N.Y. $6,419,154 (contract modification) Propellant production at the Badger Army Ammunition Plant, Baraboo, Wis. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69 C-0014.

—**Atlas Chemical Industries, Inc.**, Wilmington, Del. $5,835,011 (contract modification). TNT production at the Volunteer Army Ammunition Plant, Chattanooga, Tenn. Army Ammunition Procurement and Supply Agency, *Joliet, Ill.* DA-11-173-AMC-00531(A).

—**Remington Arms Co.**, Bridgeport, Conn. $5,153,906 (contract modification). Load, assemble and pack small caliber ammunition, Lake City Army Ammunition Plant, Independence, Mo DA-19-010-AMC-00003(A). $3,093,806 (contract modification). Load, assemble and pack small caliber ammunition, Lake City plant. DA-49-010-AMC-0003(A).

—**Eastman Kodak Co.**, Kingsport, Tenn. $4,408,057 (contract modification). Production of various explosives, Holston Army Ammunition Plant, Kingsport, Tenn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173 AMC-00035(A).

—**Firestone Tire and Rubber Co.**, Akron, Ohio. $3,846,050 (contract modification). *Load, assemble and pack ammunition,* Army Ammunition Plant, Ravenna, Ohio Army Ammunition Procurement and Sup*ply Agency, Joliet,* Ill. DA-11-173-AMC-00065(A).

—***Harvey Aluminum Sales, Inc.**, Torrance,* Calif. $1,963,233 (contract modification) Load, assemble and pack large caliber ammunition, Army Ammunition Plant, Milan, Tenn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00520(A).

—**Mason and Hanger-Silas Mason Co.**, Lexington, Ky. $5,124,178 (contract modification). Load, assemble and pack bombs and projectiles, Cornhusker Army Amm*unition Plant, Grand Island, Neb. DA-*AA09-69-C-0383. $1,591,084 (contract modification). Load, assemble and pack ammunition, Iowa Army Ammunition Plant, Burlington, Iowa. DA-AA09-68-C-0381 Army Ammunition Procurement and Supply Agency, Joliet, Ill.

—**Uniroyal, Inc.**, *New York,* N.Y. $1,307,301 (contract modification). TNT and other explosives production. Army Ammunition Plant, Joliet, Ill. Army Ammunition Pro-

curement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00062(A)

—**Day and Zimmerman & Co.**, Philadelphia, Pa. $1,945,106 (contract modification), and $1,170,497 (contract modification). Load, assemble and pack ammunition. Lone Star Army Ammunition Plant, Texarkana, Tex Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00114(A).

DEPARTMENT OF THE NAVY

2—**Dynalectron Corp.**, Washington, D.C. $1,153,915 Aircraft maintenance services in connection with operational support of missile and space programs at the Pacific Missile Range. Naval Air Station, Point Mugu, Calif. Naval Purchasing Office, Los Angeles, Calif N00123-69-C-0515.

—**Kollsman Instrument Corp.**, Elmhurst, N.Y. $1,023,281 (contract modification). Altimeter encoders for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019-68-C-0409.

5—**Johns Hopkins University**, Silver Springs, Md. $2,931,500. Increased level of effort in advanced research on surface missile systems. Naval Ordnance Systems Command, Washington, D C. NOw 62-601-C.

—**Coneen Construction Corp.**, El Cajon, Calif. $1,507,000. Construction of barracks, Naval Station, San Diego, Calif. Naval Facilities Engineering Command, Washington, D.C. N62473-68-C-0111.

—**General Time Corp.**, Skokie, Ill. $1,350,492 (contract modification). Rockeye II mechanical time fuzes, plus shipping and storage containers. Naval Air Systems Command, Washington, D.C. N00019-69-C-0154.

—**B.F. Gosser, Inc.**, Gardena, Calif. $1,110,639. Construction of additions to non-commissioned officers' club, Naval Station, Long Beach, Calif. Naval Facilities Engineering Command, Washington D.C. N62473-69-C-0008.

6—**Computer Measurements Co.**, San Fernando, Calif. $3,326,742. Manufacture transistorized electronic counters. Naval Electronic Systems Command, Washington, D.C. N00039-69-C-2604.

—**William E. Arnold Co.**, Jacksonville, Fla. $3,087,000. Construction of aircraft maintenance hanger, Naval Air Station, Cecil Field, Fla. Naval Facilities Engineering Command, Washington, D.C. N62467-68-C-0161.

9—**General Electric Co.**, Washington, D.C. $2,717,927. Guidance assemblies for Mk 3 Poseidon missiles. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0219.

—**General Dynamics Corp.**, Pomona, Calif. $1,265,000. Terrier, Tartar and Standard missiles. Naval Ordnance Systems Command, Washington, D.C. N00017-68-C-2205.

10—**Raytheon Co.**, Lowell, Mass. $3,076,212 (contract modification). Guidance and control groups for Sidewinder 1C missiles. Naval Air Systems Command, Washington, D.C. N00019-69-C-0056.

—**Kaminer Construction Corp.**, Chamblee, Ga. $1,857,000. Utilities for aircraft carrier berths, Naval Station, Mayport, Fla. Naval Facilities Engineering Command, Washington, D.C. N62467-67-0463.

1—**General Dynamics Corp.**, Groton, Conn. $5,625,000. Design, develop, fabricate and furnish classified electronic equipment for submarines. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1333.

—**Litton Systems, Inc.**, College Park, Md. $3,897,855. Target detecting devices and associated data. Naval Air Systems Command, Washington, D.C. N00019-69-C-0646.

—**United Aircraft Corp.**, Pratt and Whitney Aircraft Div., East Hartford, Conn. $2,670,000 (contract modification). Product support engineering services for T34, TF33/JT3D and J-75/J-74 series engines for the Air Force N00019-69-C-0367 $3,510,000 Production of YTF30-P-412 engines and conversion of TF30-P-12 engines to the YTF30-P-412 configuration N00019-69-C-0611 Naval Air Systems Command, Washington, D C.

—**Texas Instruments, Inc.**, Dallas, Tex $1,376,020 (contract modification) Airborne magnetic detecting sets. Naval Air Systems Command, Washington, D C. N00019-69-C-0412.

—**General Electric Co.**, Binghampton, N.Y $1,124,653 (contract modification) Increase limitation of authorization for AN/ASA-32J automatic flight control systems for the Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C 0077

12—**Newport News Shipbuilding and Dry Dock Co.**, Newport News, Va. $3,436,000 Advanced planning, design and other preparatory work for conversion of USS Nathaniel Green (SSBN 636) to C-3 Poseidon missile capability Naval Ship Systems Command, Washington, D.C. N00024-69-C 0231

—**Massachusetts Institute of Technology**, Cambridge, Mass $1,670,000 (contract modification) Continuation of design work on the Polaris guidance system. Naval Strategic Systems Project Office, Washington, D.C. N00030-68-C-0154 P002.

—**Garrett Corp.**, Phoenix, Ariz. $2,077,011. Spare parts for CTCP 100-54 and GTC 85, 56 and 72 gas turbines for F-4 and A-5 aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-67-A-2301-0629.

13—**DeLaval Turbine, Inc.**, Trenton, N.J. $2,550,000. Fuel oil pumps and associated equipment and data for the Standard Distillate Fuel Program. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5377.

—**F. A. Duke Co., Inc.**, Portsmouth, Va. $2,531,613. Construction of aircraft integration and test hangar, Naval Air Station, Norfolk, Va. Naval Facilities Engineering Command, Washington, D.C. N62470-69-C-0742

—**Woods Hole Oceanographic Institution**, Woods Hole, Mass. $2,272,072. Oceanographic studies. Office of Naval Research, Washington, D.C. N00014-66-C-0241 Mod G07

—**Philco Ford Corp.**, Willow Grove, Pa. $1,400,000. Command data display groups. Naval Purchasing Office, Los Angeles, Calif. N00123-69-C-0815.

—**Hartman Systems Co., Inc.**, Huntington Station, N.Y. $1,260,000. 35 navigational plotting systems, pre-production equipment, and associated training and technical data. Naval Ships Systems Command, Washington, D.C. N00024-69-C-5517.

—**Massachusetts Institute of Technology**, Cambridge, Mass. $1,500,000 Additional research on computer theory and communications techniques. Office of Naval Research, Washington, D.C. NONR 4102 (01).

16—**Bendix Corp.**, Baltimore, Md. $4,538,177 (contract modification). Airborne receiver transmitters and associated equipment. Naval Air Systems Command, Washington, D.C. NOw 66-0637.

—**Collins Radio Co.**, Richardson, Tex. $3,186,666 (contract modification). Airborne VLF communications systems. Naval Air Systems Command, Washington, D.C. N00019-67-C-0382.

—**Litton Systems, Inc.**, Silver Spring, Md. $2,350,153. Countermeasure transmitting sets and ancillary items for the Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0611.

—**General Dynamics Corp.**, Pomona, Calif. $1,232,273 (contract modification). Incremental funding for research and development on the Standard ARM missile. Naval Air Systems Command, Washington, D.C. N00019-68-C-0400.

—**Lockheed Aircraft Corp.**, Sunnyvale, Calif. $2,500,000. Poseidon Advance Guidance Development Support Program. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0100.

—**Christenson-Raber Kief and Associates**, Seattle, Wash. $2,103,200. Construction of aircraft parking apron, Naval Air Station, Whidbey Island, Wash. Naval Facilities Engineering Command, Washington, D.C. N62476-69-C-0022.

—**Wexler Construction Co., Inc.**, Newton Highlands, Mass. $1,292,235. Construction of Armed Forces Reserve Training Center, Lawrence, Mass Naval Facilities Engineering Command, Washington, D.C. N62464-67-C-0005

—**Bendix Corp.**, Teterboro, N.J $1,115,000 Mobile adapters used in conjunction with AN/GSM 133 automatic program test sets for overhaul and repair of F-4 series aircraft. Naval Purchasing Office, Los Angeles, Calif. N00123-69 C-1392.

19—**Sippican Corp.**, Marion, Mass. $10,044,044. Expendable bathythermograph equipment, including probes, recorders, launchers and spare parts. Naval Ship Systems Command, Washington, D.C. N00024 69-C-1386

—**Sperry Rand Corp.**, St Paul, Minn. $5,709,191 (contract modification) AN/ASQ avionic computers for P-3C aircraft Naval Air Systems Command, Washington, D.C. N00019-69-C-0295.

—**Sylvania Electric Products, Inc.**, Needham Heights, Mass. $1,295,439. Design and development of a Real Time Digital Signal Processor System Naval Air Development Center, Johnsville, Pa N62269-69-C 0206

—**North American Rockwell Corp.**, Columbus, Ohio. $1,012,000. Design, development, fabrication and test of a Naval Intelligence Processing System. Naval Air Systems Command, Washington, D.C. N00019-68-C-0525.

23—**Singer-General Precision Inc.**, Wayne, N.J. $1,067,000 (contract modification) Research on guidance systems for Poseidon missiles. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0086.

24—**Hazeltine Corp.**, Little Neck, N Y. $9,032,997. Airborne interrogator sets for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0538.

—**General Electric Co.**, Utica, N.Y. $6,444,422 (contract modification) AN/AYA-8 data processing systems for P 3C aircraft. Naval Air Systems Command, Washington, D.C. N00019-69-C-0270.

—**United Aircraft Corp.**, East Hartford, Conn. $5,716,890 (contract modification). J52-P-8A engines. Naval Air Systems Command, Washington, D.C. N00019 67 C-0182.

—**Stromberg Datagraphics, Inc.**, San Diego, Calif. $2,065,372 (contract modification). Airborne tactical display systems. Naval Air Systems Command, Washington, D.C. N00019-69-C-0302.

—**Raytheon Co.**, Lexington, Mass. $2,743,420 (contract modification). Guidance and control groups for the Chaparral missile. Lowell, Mass. N00019-69-C-0200. $1,232,056 (contract modification). Incremental funding for Sparrow III missiles. Bedford, Mass. N00019-67-C-0019. $18,734,628 (contract modification). Guidance and control groups for Sparrow III missiles. Lowell, Mass., Bristol, Tenn., and Oxnard, Calif. N00019-69-C-0358. Naval Air Systems Command, Washington, D.C.

—**T. L. James and Co., Inc.**, Ruston, La. $1,424,490. Taxiway rehabilitation and runway repairs, Air National Guard Permanent Training Site, Municipal Airport, Gulfport, Miss. Naval Facilities Engineering Command, Washington, D.C. N62468-69-C-0200.

25—**G. L. Cory, Inc.**, San Diego, Calif. $3,642,580. Construction of an avionics facility for the Naval Air Rework Facility, North Island Naval Air Station, Calif. Naval Facilities Engineering Command, Washington, D.C. N62473-68 C 0135.

—**Singer General Precision Corp.**, Silver Spring, Md. $3,000,000. Dual position anti-submarine acoustic sensor operator trainers, VP DIFAR 2 device 14B38. Naval Training Device Center, Orlando, Fla. N61339-69-C-0260.

—**D and A Equipment Co., Inc.**, Pensacola, Fla. $2,648,000. Construction of a dispensary and dental clinic, Naval Training Center, Orlando, Fla. Naval Facilities Engineering Command, Washington, D.C. N62467-67-C-0183.

—**Construction Services Co., Inc.**, Isle of Palms, S.C. $1,267,773. Construction of a dispensary, Marine Corps Recruit Depot, Parris Island, S.C. Naval Facilities Engineering Command, Washington, D.C. N62467-67-C-0671.

26—**FMC Corp.**, Minneapolis, Minn. $4,452,000. Increase of limitation of authorization for combined Guided Missile Launcher System Mark 26, Mods 0, 1 and 2. Fridley, Minn. Naval Ordnance Systems Command, Washington, D.C. N00017-68-C-2109.

—Fred A. Arnold, Inc., Los Angeles, Calif. $3,192,000. Construction of an electronic weapons precision facility, Naval Shipyard, San Francisco, Calif. Naval Facilities Engineering Command, Washington, D.C. N62474-68-C-0108.

—General Motors Corp., Goleta, Calif $1,150,000. Production of electronic assemblies for Mk. 48 torpedoes Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-1306.

27—Raytheon Co., Sudbury, Mass. $25,256,155. Poseidon guidance system electronics assemblies and components Waltham, Mass Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0127.

—Hazeltine Corp., Little Neck, N.Y. $1,065,849 (contract modification). Classified electronic equipment. Naval Air Systems Command, Washington, D.C. N00019-69-C-0396.

—North American Rockwell Corp., Columbus, Ohio. $5,040,000. OV-10B aircraft Naval Air Systems Command, Washington, D C. N00019-69-C-00696.

—Hughes Aircraft Co., Canoga Park, Calif. $1,301,000. Continued development of an advanced short range infrared air-to-air missile guidance system. Naval Air Systems Command, Washington, D.C. N00019-69-C-0631.

—PRD Electronics, Inc., Jericho, N.Y. $8,184,800 (contract modification). VAST (Versatile Avionics Shop Test) stations for A-7E aircraft. Naval Air Systems Command, Washington, D.C. N00019-69-C-0334.

—PRD Electronics, Inc., Westbury, N.Y. $4,604,323 (contract modification). Increase in limitation of authorization for VAST building blocks and data transfer units. Naval Air Systems Command, Washington, D.C. N00019-68-C-0449

—Dyson and Co., Pensacola, Fla. $1,106,824. Construction of a deep ocean engineering pressure building, Naval Ships Research and Development Laboratory, Panama City, Fla. Naval Facilities Engineering Command, Washington, D.C. N62467-69-C-0070.

—Gravier and Harper, Inc., Alexandria, La. $3,617,000. Construction of a composite medical facility, England AFB, La. Naval Facilities Engineering Command, Washington, D.C. NBy 90393.

—American Shipbuilding Co., Lorain, Ohio. $5,458,655. Construction of a 275-foot Patrol Escort (PF) ship. Naval Ship Systems Command, Washington, D.C. N00024-69-C-0318.

—Raytheon Co., Hawthorne, Calif. $1,980,000. Rebuilding nine radar systems (AN/TPS-22). Marine Corps Headquarters, Washington, D.C. M00027-69-C-0208.

—Bendix Corp., Owings Mills, Md. $1,800,000. Rebuilding of nine AN/TPS-34A/B radar systems. Marine Corps Headquarters, Washington, D.C. M00027-69-C-0207.

30—RCA Corp., Van Nuys, Calif. $1,388,880. classified electronic countermeasure equipment. Naval Ship Systems Command, Washington, D.C. N00024-69-1396.

—Sanders Associates, Inc., Nashua, N.H. $1,336,032. Two units of classified electronic countermeasure equipment. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1445.

—Hughes Aircraft Co., Fullerton, Calif. $1,255,400. Design and development of Navy Tactical Data Systems modified data display. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1260.

—General Dynamics Corp., Groton, Conn. $9,454,450. Overhaul and alteration of USS Dace (SSN-607). Naval Ship Systems Command, Washington, D.C. N00024-68-C-0273.

—Singer-General Precision, Inc., Glendale, Calif. $2,947,338. Automatic data recording equipment. Naval Regional Procurement Office, Brooklyn, N.Y. N00140-69-C-0337.

—Fred Loffredo, Lafayette Hill, Pa., $1,725,000. Construction of barracks at Naval Station, Philadelphia. Naval Facilities Engineering Command, Washington, D.C. N62472-69-C-0053.

—North American Rockwell Corp., Anaheim, Calif. $4,471,000. Equipment pertaining to ASB12 bomb directional sets for RA-5C aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-69-A-0005-0033.

—American Cement Corp., Los Angeles, Calif. $4,672,500. Type 1 Portland cement in commercial export bags (containerized). Crestmore, Calif. Naval Purchasing Office, Los Angeles, Calif. N00123-69-D-2122.

—Maxson Electronics Corp., Great River, N.Y. $1,313,234 Electronic warfare trainer devices, 15E28. Naval Training Device Center, Orlando, Fla. N61339-69-C-0311.

—Computer Sciences Corp., Silver Spring, Md $5,579,361. Research and development of Acoustic Intelligence Data System. Navy Purchasing Office, Washington, D.C. N00600-69-C-1166.

DEPARTMENT OF THE AIR FORCE

4—Hughes Aircraft Co., Culver City, Calif. $1,172,477. Production of modification kits and supporting technical data applicable to the F-4C and F-4D aircraft Tucson, Ariz. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F04606-68-S-0225-QP12.

5—Boeing Co., Seattle, Wash. $1,960,000. Production of components applicable to the second stage of various launch vehicles Space and Missile Systems Organization, (AFSC), Los Angeles, Calif. F04701-69-C-0072.

—General Dynamics Corp., Fort Worth, Tex. $1,421,259. Modification and repair of B-58 aircraft. Waco, Tex. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex. F41608-68-C-2200.

6—General Electric Co., Utica, N.Y. $3,233,400. Production of spare parts for airborne radar equipment. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F34601-68-A-2090.

—Goodyear Aerospace Corp., Akron, Ohio. $1,455,582. Production of large cargo pallets adapted for mechanized loading and unloading of air cargo. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F34601-69-A-1044.

11—Fairchild Hiller Corp., Germantown, Md. $15,180,593. Repair and modification of C-119 aircraft. St. Augustine, Fla. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-68-C-1083.

17—Radio Corporation of America, Moorestown, N.J. *$4,340,000. Operation and maintenance of radar tracking facilities.* Moorestown, N.J., Lexington, Mass., Kwajalein, Marshall Islands, Honolulu, Hawaii, and San Francisco, Calif. Electronic Systems Division, (AFSC), L. G. Hanscom Field, Mass. F18628-69-C-0186.

—C. W. Matthews Contracting, Co., Inc., Marietta, Ga. $1,739,974. Repair and replace aircraft parking apron, Charleston AFB, S.C. *437th Military Air Wing,* Charleston AFB, S.C. F38610-69-C-0193.

—Boeing Co., Renton, Wash. $1,034,868. Modification kits for C-135 aircraft. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F04606-68-A-0149.

18—McDonnell Douglas Corp., St. Louis, Mo. $2,322,600. Modification kits for F-4D aircraft. Robertson, Mo. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F34601-69-A-2245.

19—Northrop Corp., Palos Verdes Peninsula, Calif. $1,108,864. Modification kits for the Minuteman weapon system. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah. F42600-69-C-1979.

—Chicago Aerial Industries, Inc., Barrington, Ill. $2,883,891. Procurement of aerial photographic equipment. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-1085.

—Sylvania Electric Products, Inc., Needham Heights, Mass. $1,263,610. Depot maintenance for the tactical satellite communication program. Electronic Systems Division, (AFSC), L. G. Hanscom Field, Mass.

—Federal Electric Corp., Paramus, N.J. $73,644,354. Operation and maintenance of the Dewline, the North Atlantic Radio System, and the communication and electronic system at Thule AB, Greenland. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-C-1108.

20—Serv-Air Inc. of North Carolina, Enid, Okla. $8,953,259. Operation and maintenance services, Vance AFB, Okla. F41608-69-C-3649. $2,472,926. Operation and maintenance services, Sheppard AFB, Tex F41608-69-C-3672. San Antonio Air Materiel Area, (AFLC), Kelly AFB, Tex.

—Sylvania Electronic Products, Inc., Needham Heights, Mass. $1,978,000 Digital data modems. Electronics Systems Division, (AFSC), L. G. Hanscom Field, Bedford, Mass. F19628-69-C-0278.

—Koppers Co., Baltimore, Md. $1,733,958 Noise suppressor system for F-4 aircraft Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-1195.

—American Electric, Inc., La Mirada, Calif $1,590,206. 500-pound bombs. Ogden Air Materiel Area, (AFLC), Hill AFB, Utah F42600-69-C-3290.

23—Federal Electric Corp., Paramus, N J. $36,766,054. Operation, maintenance and logistic support of the White Alice communications system, Alaska. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif F04606-69-C-0894.

—Federal Electric Corp., Paramus, N.J. $49,406,517. Services and materials for the operation, maintenance and logistics support of the Ballistic Missile Early Warning System (BMEWS). Thule AB, Greenland, Clear, Alaska, and Paramus. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-C-0556.

—RCA Service Co., Camden, N.J. $7,300,000. Operation, maintenance and logistics support of the BMEWS. Thule, Greenland, Clear, Alaska, and Camden. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-C-1256.

—RCA Service Co., Camden, N.J. $3,207,195. Operation, maintenance and logistics support of the White Alice communications system. Anchorage, Alaska. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-C-1257.

—General Electric Co., Cincinnati, Ohio. $71,563,200. Production of J-79-GE-17 engines and spare parts for ground equipment for RF-4E aircraft. Evendale, Ohio. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-1232.

24—Hayes International Corp., Birmingham, Ala. $1,366,033. Management services and world-wide distribution of Air Force publications. Middle River, Md. Procurement Division, 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33601-67-C-0353.

—Lockheed Aircraft Corp., Ontario, Calif. $14,705,000. Maintenance services for TF-104G aircraft. Luke AFB, Ariz. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-70-C-0003.

25—Industrial Acoustics Co., Bronx, N.Y. $1,818,244. F-111 noise suppression systems. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-1032.

—Lockheed Aircraft Corp., Marietta, Ga. $5,091,065. Engineering, design, fabrication and installation of modified wings on C-130B/E aircraft. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-68-C-2530-P005.

—Litton Systems, Inc., Woodland Hills, Calif. $1,460,000. Repair of gyroscopes for F-4 aircraft. Oklahoma Air Materiel Area, (AFLC), Tinker AFB, Okla. F04606-68-A-0147.

26—McDonnell Douglas Corp., Tulsa, Okla. $15,800,000. Modification, and inspection and repair as necessary (IRAN) of B-52 aircraft for FY 1970. Oklahoma City Air Materiel Area, (AFLC), Tinker AFB, Okla. F34601-69-C-4368.

27—Radio Corp. of America, Moorestown, N.J. $1,887,840. Operation and maintenance of the Moorestown radar tracker/sensor facility. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F33657-69-C-1124.

—Elder-Oilfield, Inc., Houston, Tex. $7,925,158. Production of 880 modular prefabricated two-story housing units. Vicksburg, Miss. Air Forces Supply and Services, Washington, D.C. F41621-69-C-0089.

—Motorola, Inc., Scottsdale, Ariz. $19,932,021. FMU-56/B and FMU-56A/B fuzes. Armament Development and Test Center, Eglin AFB, Fla. F33657-69-0237.

—Bendix Corp., Towson, Md. $2,446,136. Modification and improvement of the AN/FPS-85 space track radar. Rome Air Development Center, (AFSC), Griffiss AFB, N.Y. AF30(602)-2763.

—Litton Systems, Inc., Woodland Hills,

Calif. $4,677,047. Production of component parts and aerospace ground equipment for airborne navigational aids. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-1124.

30—American Coleman Co., Littleton, Colo. $1,647,400. Production of aircraft towing tractors (MB-4). Warner-Robins Air Materiel Area, (AFLC), Robins AFB, Ga F09603-69-4874.

—Textron, Inc., Belmont, Calif $2,221,810. Spare parts in support of AN/APS-109 radar homing and warning system for F-111 aircraft. Warner Robins Air Materiel Area, (AFLC), Robins AFB, Ga. F09603-69-A-0169.

—White Glove Building Maintenance, Inc., Los Angeles, Calif. $1,192,824. Custodial services from July 1, 1969, to June 30, 1970, at Los Angeles AFS. Space and Missile Systems Organization (AFSC), Los Angeles, Calif. F04693-29-C-0044.

—Industrial Security Systems, Inc., Sherman Oaks, Calif. $1,924,710. Security guards and related services at Los Angeles AFS. Space and Missile Systems Organization (AFSC), Los Angeles, Calif. F04693-69-C-0049.

—Calavar Corp., Santa Fe Springs, Calif. $8,278,462. Truck-mounted servicing platforms for C-5A aircraft Aeronautical Systems Division (AFSC), Wright-Patterson AFB, Ohio. F33657-69-C-1361

—Fairchild Hiller Corp., Farmingdale, N.Y. $1,553,895. Modification and test flight of F-105 aircraft weapons delivery system. Sacramento Air Materiel Area (AFLC), McClellan AFB, Calif F04606-68-C-1055

—Kollsman Instrument Corp., Elmhurst, N.Y. $1,045,579. Production of pressure-temperature test sets, TTU 205B/E. San Antonio Air Materiel Area (AFLC), Kelly AFB, Tex. F41608-69-D-0020.

—Westinghouse Electric Corp., Baltimore, Md. $1,797,598. Modification of B-57G aircraft, revised aerospace ground equipment and data requirements Aeronautical Systems Division (AFSC), Wright-Patterson AFB, Ohio. F33657-68-C-1050-P041.

—General Dynamics Corp., Fort Worth, Tex. $1,300,000. Update and expension of Air Force electronic warfare evaluation simulator. Aeronautical Systems Division (AFSC), Wright-Patterson AFB, Ohio. F33615-69-C-1705.

—Ryan Aeronautical Co., San Diego, Calif. $1,078,000. Maintenance and operation of the Drone Control Facility at Tyndall AFB, Fla., for FY 1970. Aerospace Defense Command, Ent AFB, Colo. F08637-69-C-0243.

—Massachusetts Institute of Technology, Cambridge, Mass. $5,531,004. General research and space communications of interest to Army, Navy, Air Force, and Advanced Research Projects Agency. Lexington, Mass. Electronic Systems Division (AFSC), L. G. Hanscom Field, Mass. AF19(628)5167.

—Consolidated Systems, Inc., Studio City, Calif. $2,668,550. Base support services, including procurement support, property control, and transportation at Los Angeles AFS. Space and Missile Systems Organization (AFSC), Los Angeles. Calif. F04693-69-C-0055.

—Martin-Marietta Corp., Denver, Colo. $33,-179,829 (contract modification). Design, development, fabrication and delivery of Titan III-D space booster and associated aerospace ground equipment. Space and Missile Systems Organization (AFSC), Los Angeles, Calif. 04695-67-C-0041.

—The following five contracts have been awarded by the Military Airlift Command, Scott AFB, Ill.:

Airlift International, Inc., Miami, Fla. $4,196,160. Domestic cargo air transportation services in support of AFLC LOGAIR System. F11626-69-C-0038.

Reeve Aleutian Airways, Inc., Anchorage, Alaska. $1,138,217. Air transportation services for movement of personnel and cargo between Elmendorf AFB and various stations within Alaska. F11626-69-D-0009.

Universal Airlines, Inc., Ypsilanti, Mich. $19,609,694. Domestic cargo air transportaiton in support of AFLC LOGAIR System. F11626-69-C-0039.

Overseas National Airways, Inc., Jamaica, N.Y. $6,666,354. Domestic air transportation in support of AFLC LOGAIR Cystem. F11636-69-C-0040.

Overseas National Airways, Inc., Jamaica, N.Y. $10,940,970. Domestic cargo air transportation services in support of Navy QUICKTRANS System F11626-68-C-0041.

OFF SHORE PROCUREMENT

25—Canadian Commercial Corp., Ottawa, Ontario, Canada $5,491,114. Nonpersonal services, data and logistics support for FY 1970-72 operation and maintenance of the USAF-Canadian Northeast Wideband System, and operation and maintenance of base support functions at four air stations in Canada. Sacramento Air Materiel Area, (AFLC), McClellan AFB, Calif. F04606-69-C-0896.

—Canadian Commercial Corp., Ottawa, Ontario, Canada $1,494,498. Mobile automatic test sets for avionics support equipment Rexdale, Ontario, Canada. Naval Air Systems Command, Washington, D.C. N00019-69-C-0616.

27—Canadian Commercial Corp., Ottawa, Ontario, Canada. $3,896,484. Production of telegraph-telephone terminal sets and related items of equipment. Radio Engineering Products, Campbellton, New Brunswick, Canada. Marine Corps Headquarters, Washington, D.C.

Asbestos Fibers Studied for Aircraft Structures

Asbestos fibers may be used to reinforce epoxy resin matrixes used in aerospace structures, if an Air Force Materials Laboratory study proves correct. The laboratory is presently evaluating the use of asbestos fiber reinforced plastics in the construction of air-to-ground missiles. In preliminary tests, the asbestos fibers cut costs of composites considerably. Other composite reinforcement materials cost from $7.50 to $300 per pound, while asbestos is only $1. And when used as a replacement for aluminum in a missile case, asbestos reduced the cost from $500 to $150.

The main reasons for considering asbestos fibers were low cost, availability, heat and corrosion resistance, and high strength. As used in composites, asbestos fibers are 25 percent lighter than aluminum, and less detectable by radar than metal structures.

Major problems still unsolved, however, are finding a chemical treatment that will give better adhesion to the fiber surface, and compiling adequate design data and processing information.

Preliminary tests, conducted on epoxy resin and unidirectional short fiber crocidolite asbestos fibers, have shown that the asbestos fibers give flexural and compressive strengths and specific flexural and compressive modulus values approximately 15 percent above those of equivalent glass fiber composites.

Engineers believe that this preliminary data indicates that asbestos' high inherent strength and stiffness can be translated into low-cost, high-performance composites for use in sandwich skins for aircraft, in the same manner that boron, glass and graphite filaments are now used.

Project engineer on the work now being conducted at the Air Force Materials Laboratory, Wright-Patterson AFB, Ohio, is T. J. Reinhart of the Materials Support Division.

FY 1970 Industrial Security Management Course Dates Set

The Defense Department has scheduled the following sessions of the Industrial Security Management Course during FY 1970, to be held at Fort Holabird, Md.: Sept. 22-26; Dec. 1-5; Feb. 2-6, 1970; March 16-20, 1970; and May 4-8, 1970. Contractors interested in attending any one of these sessions should contact their cognizant security office.

Field extensions for the security management course will also be offered, at the following places and dates, hosted by their respective Defense Contract Administration Services Region (DCASR):

Orlando, Fla., Oct. 6-10. Atlanta DCASR, 3100 Maple Dr., NE, Atlanta, Ga. 30305. Phone (404) 261-7310, Ext. 206, 207.

Boston, Mass., Oct. 13-17. Boston DCASR, 666 Summer St., Boston, Mass. 02210. Phone (617) 542-6000, Ext. 804, 805.

Cincinnati, Ohio, June 15-19, 1970. Cleveland DCASR, Federal Office Building, 1240 E. 9th St., Cleveland, Ohio 44199. Phone (216) 522-5334.

Los Angeles, June 22-26, 1970. Los Angeles DCASR, 11099 S. LaCienega Blvd., Los Angeles, Calif. 90045. Phone (213) 643-1084.

Reservations for the extension courses should be placed with the host DCASR.

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Aircraft Vibration Target of Air Force Study

The Air Force Materials Laboratory, Wright-Patterson AFB, Ohio, has developed new uses for "damping," or vibration reducing, materials to increase the life of aircraft components.

The Flight Dynamics Laboratory, also at Wright-Patterson, brought the problem to the attention of the Materials Laboratory Strength and Dynamics Branch. A fix was defined when F–100 antennas began failing after a few missions. From this, a nitrile rubber split-ring damper was developed and fabricated that attached to the electrical connector at the center of the antenna.

This viscoelastic damper, tuned to frequency of the structure at the attachment point, dissipated the energy, instead of transmitting it to the antenna. The result was a 12-fold increase in antenna life.

The Materials Laboratory is continuing work on vibration materials in an effort to eliminate vibration problems in all kinds of aircraft and spacecraft, and to advance the state of the art.

Army Sets Up Task Force for Night Vision Devices

"Task Force Riposte," charged with the responsibility of planning and monitoring the integration of all surveillance, night vision and target acquisition devices into the Army, has been created by the Army Combat Developments Command (CDC) Fort Belvoir, Va.

For the first generation of night vision devices now entering service, Riposte will validate the requirements for such equipment write doctrine for its use, and place the devices within the Army's Tables of Organization and Equipment. Riposte will also evaluate field and troop tests of the devices.

The long-range mission of Riposte will be to develop requirements for second-generation equipment for the Army through 1985 The goal is a family of devices enabling field troops to see in darkness, detect the enemy, and direct fire on target.

Contemporary and future night detection devices are of three varieties: radar, night vision devices, and sensors. Radar and infrared night vision devices are limited, however, by their emissions which can be monitored by the enemy. Starlight scopes, electro-optical instruments which amplify existing light, and sensors are passive, virtually undetectable, and seem promising as both offensive and defensive night detection devices.

Sensors, relatively new in development, can be made to detect human, ferrous metal, or mechanical emanations. Conceivably, they could be made to detect the passage of anything from people to motorcycles to trucks, indicating the amount of ferrous metals present, and the numbers passing any given point.

This information, according to CDC, could then be relayed to remote collection centers, where computers would compile and evaluate the data. Artillery, air strikes, or field operations could then be directed to counter enemy movements or concentrations.

These second generation night detection devices will be designed for use by the individual rifleman, the unit and tank commanders backing him, and the airmobile commander overhead.

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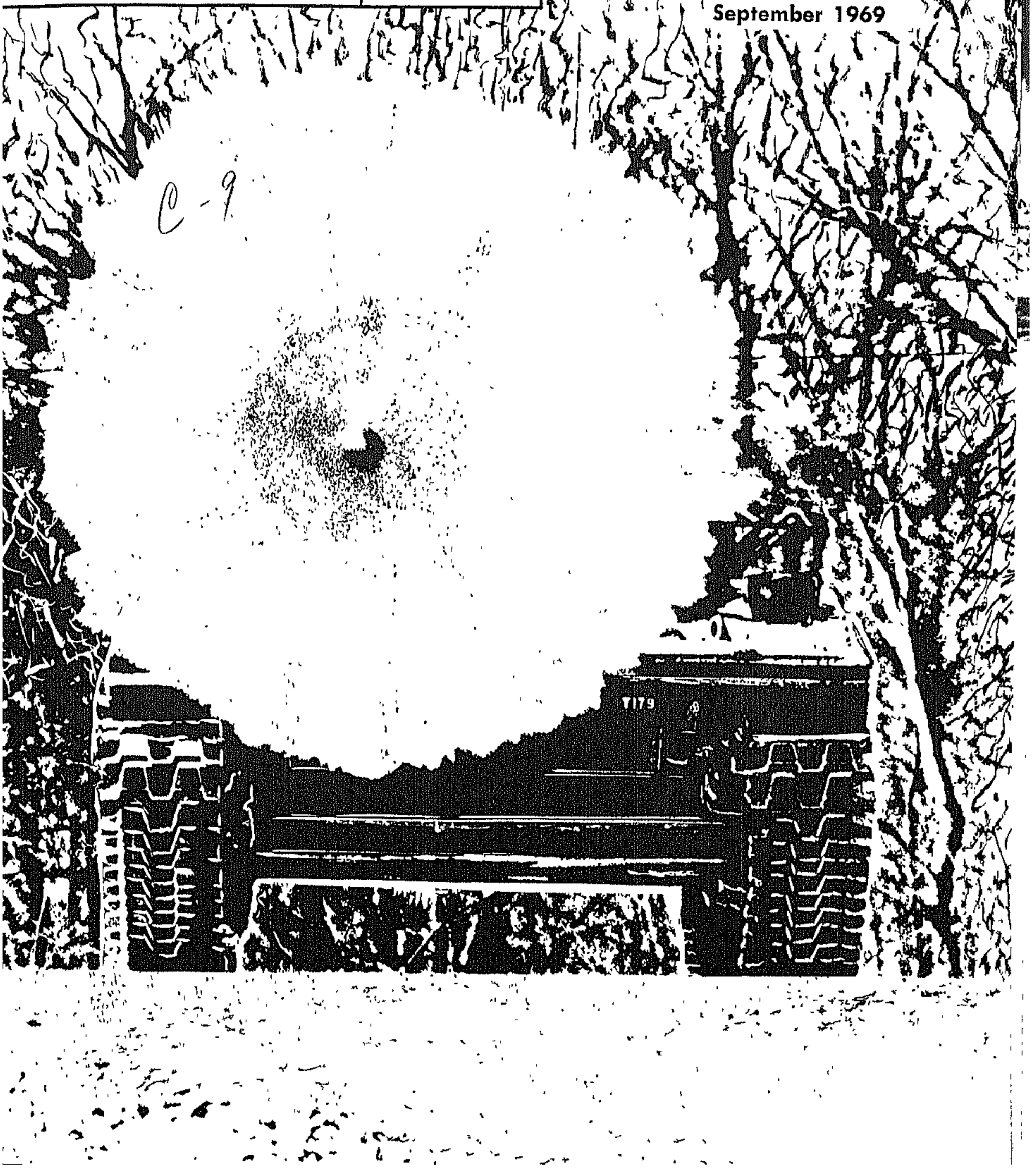
DEFENSE INDUSTRY BULLETIN

September 1969



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The *Bulletin* serves as a means of communication between the Department of Defense, its authorized agencies, defense contractors and other business interests. It provides guidance to industry concerning official DOD policies, programs and projects and seeks to stimulate thought on the part of the Defense-Industry team in solving problems allied to the defense effort.

Suggestions from industry representatives concerning possible topics for future issues are welcomed and should be forwarded to the Editor at the address shown below.

The *Bulletin* is distributed free of charge to qualified representatives of industry and of the Departments of Defense, Army, Navy, and Air Force. Subscription requests should be submitted on company letterhead stationery, must indicate the position title of the requestor and be addressed to the Editor, Defense Industry Bulletin, OASD (PA), Pentagon, Washington, D. C. 20301.

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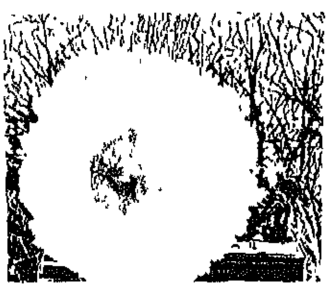
IN THIS ISSUE

FEATURES

DEPARTMENTS

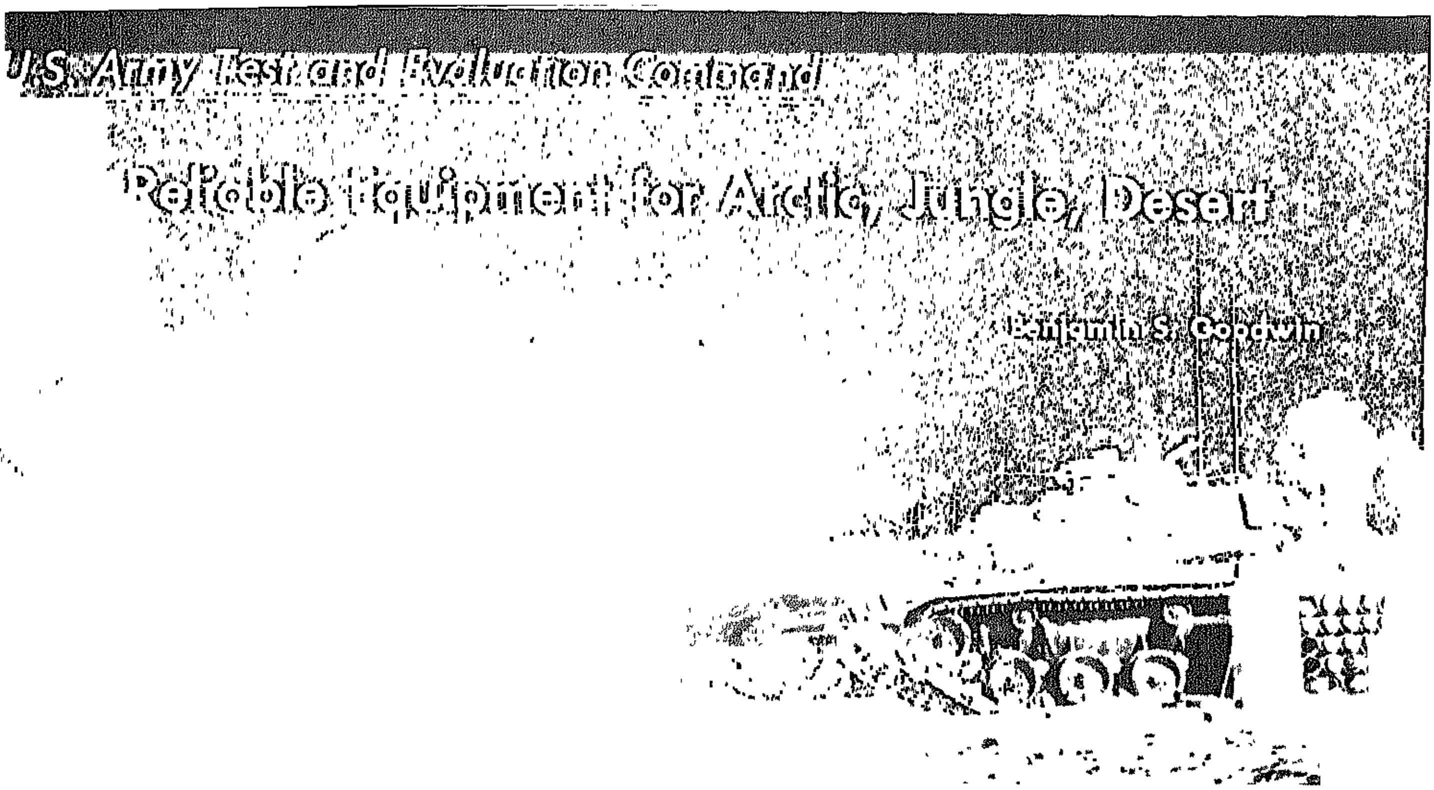


Resembling a gigantic blossom, the Shillelagh missile is caught at the moment of firing from its Sheridan launch vehicle in the photo on the cover. Testing and evaluating new armored vehicles is just one facet of the mission of the Army Test and Evaluation Command, whose story is featured in this issue.

U.S. Army Test and Evaluation Command

Reliable Equipment for Arctic, Jungle, Desert

Benjamin S. Goodwin



Of all the soldierly skills, probably the least static today is the age-old art of logistics.

If it is to succeed at all, the essential military business of "moving, supplying and quartering troops" must be conducted in an atmosphere of bold enterprise. It tolerates no plateau of achievement but demands continuous exploitation of each successful assault on the frontiers of knowledge. The alternative—tacit acceptance of the *status quo*—offers only dismal prospects for American arms.

In an age which is, literally, reaching for the stars, the military necessity for keeping up with the headlong pace of modern technology, management and industrial development is clearly demonstrable. It is reflected in the 1962 reorganization of the Army.

Among other things, the reorganization called for a major overhaul of the existing logistics and materiel structure, plus a realignment of basic responsibilities along functional lines. It also demanded more effective management of research, development and logistics resources and, especially, the accelerated delivery of new weaponry and equipment.

Since 1962, the three major Army field commands have shared in a forward-looking system for the development, procurement and support of Army materiel and equipment. Their individual tasks are unique but so closely related that it is sometimes hard to tell where the responsibilities of one leave off and those of the others begin.

- The Combat Developments Command (CDC), for instance, is charged with establishing requirements. It provides the detailed blueprints which determine how the Army will fight, how it will be organized, and how it will be equipped in all future time frames and environments.
- The Continental Army Command (CONARC) is responsible for the timely delivery of trained fighting units, organized and equipped to meet the requirements spelled out by CDC.
- At the same time, the Army Materiel Command (AMC) is expected to develop, produce, supply and maintain the panoply of weapons, equipment and other gear that will be required by the combat forces. With a few exceptions, management of wholesale materiel activities is largely the province of AMC, currently and aptly described as the *Arsenal for the Brave.*

From the beginning, AMC has not hesitated to apply brave new concepts to its massive logistics mission. Not the least of these were sweeping changes in the materiel development process itself and the establishment of an independent materiel testing organization—the U.S. Army Test and Evaluation Command (TECOM) at Aberdeen Proving Ground, Md.

The materiel development process is, largely, an in-house-initiated undertaking. While some items on the Army shopping list can be obtained directly from commercial sources, *e.g.* non-tactical automotive vehicles and aircraft, most of them are the end-product of deliberate research, development, test and evaluation programs initiated by the Army team.

Where the development process starts depends, in a sense, on the nicety of an individual's semantics and his appreciation of technical verbiage. The evolutionary path of most Army hardware, however, is marked plainly and, by and large, the formal metes and bounds are easy to identify.

From concept to disposal, the typical life cycle of Army materiel covers a span of about 30 years, by definition, a full human generation. Six distinct phases are evident in this pattern. Concept and definition stages, varying widely in duration and depth, are succeeded, normally, by a 4-year development cycle, an 8-year production phase, and a 10-year service life. Understandably, all projects do not conform to these ideals: the M1911 automatic pistol, for example, still tops the list of standard side arms.

The development phase, with which TECOM is concerned, generally opens

with the establishment of requirements and ends with type classification actions to categorize an item or system according to its suitability for service use. Requirements documents, produced by CDC, include qualitative materiel development objectives (QMDOs), qualitative materiel requirements (QMRs), and small development requirements (SDRs).

The QMR is a statement, approved by the Department of the Army, of a military need for a specific item, system, or assemblage, the development of which is believed feasible. A QMR describes the desired capabilities of the proposed item, its technical and military characteristics, and the operational and organizational environment in which it is to be used. Similarly, SDRs are issued to cover items that can be developed at relatively low cost in short periods of time. The QMDO usually precedes the QMR in point of time, and is associated with proposed requirements in which it appears that further research and study are necessary to determine feasibility.

With an approved QMR or SDR in hand, AMC is ready to begin the task of translating requirements into hardware or, more likely, into technical information and data suitable for use on the production line.

TECOM
Mission and Organization

The Test and Evaluation Command, a subordinate element of AMC and a burgeoning newcomer to Army logistics, serves as the Army's principal materiel testing organization. It provides the Army with independent, unbiased appraisals of its materiel. It also provides testing support beyond the in-house capabilities of developing and producing commands and contractors. From its test report, TECOM's only product, the Army can determine if an item conforms to specifications, if it is capable of doing the things it was built to do, and if it is, in fact, suitable for field use.

The physical plant maintained by TECOM includes the facilities of 15 proving grounds, service test boards, environmental test centers and a general equipment test activity. Some of the Army's largest reservations are among the command's test sites in the continental United States, Alaska and Panama.

With a military and civilian work force of about 20,000, TECOM is prepared to test Army materiel of almost every description under closely controlled laboratory conditions, in the field, and in the most extreme natural environments. While the bulk of its work is conducted in temperate regions, test operations go on continuously in the arid western deserts, in the humid jungles and rain forests of the tropics, in howling arctic blizzards.

Management of this far-flung test complex by TECOM is accomplished by a modest size headquarters group, located at Aberdeen Proving Ground, Md. The headquarters is a conventional directorate-type organization with special provisions for accomplishing its complicated test and evaluation mission. Some of its unusual features include:

- A coordinating staff, consisting of eight commodity-oriented materiel testing directorates, under the deputy chief of staff.
- A Plans and Operations Directorate responsible for regulating test and evaluation activities of the command; scheduling test projects; controlling installation workloads; supervising the command-wide instrumentation program and instrumentation research and development; review and analysis of test reports; and exercising staff responsibility for test policy, procedures and regulations.
- A highly sophisticated Management Science and Data Systems Office concerned with developing management techniques and information systems.
- Systems test managers responsible for directing major test programs which require special command attention.

Testing Philosophy

Operations of the command today are geared to a mature testing philosophy which, of necessity, leans heavily on standardization and centralized authority. With about 4,000 heterogeneous tests or testing tasks continuously on the books, keeping track of day-to-day activities is a formidable task. Computer applications provide the basic data for making intelligent management decisions quickly and accurately. The establishment of uniform procedures has paid the highest dividends in terms of management and control—and has contributed immeasurably to a commonality of understanding between developer, producer and tester alike.

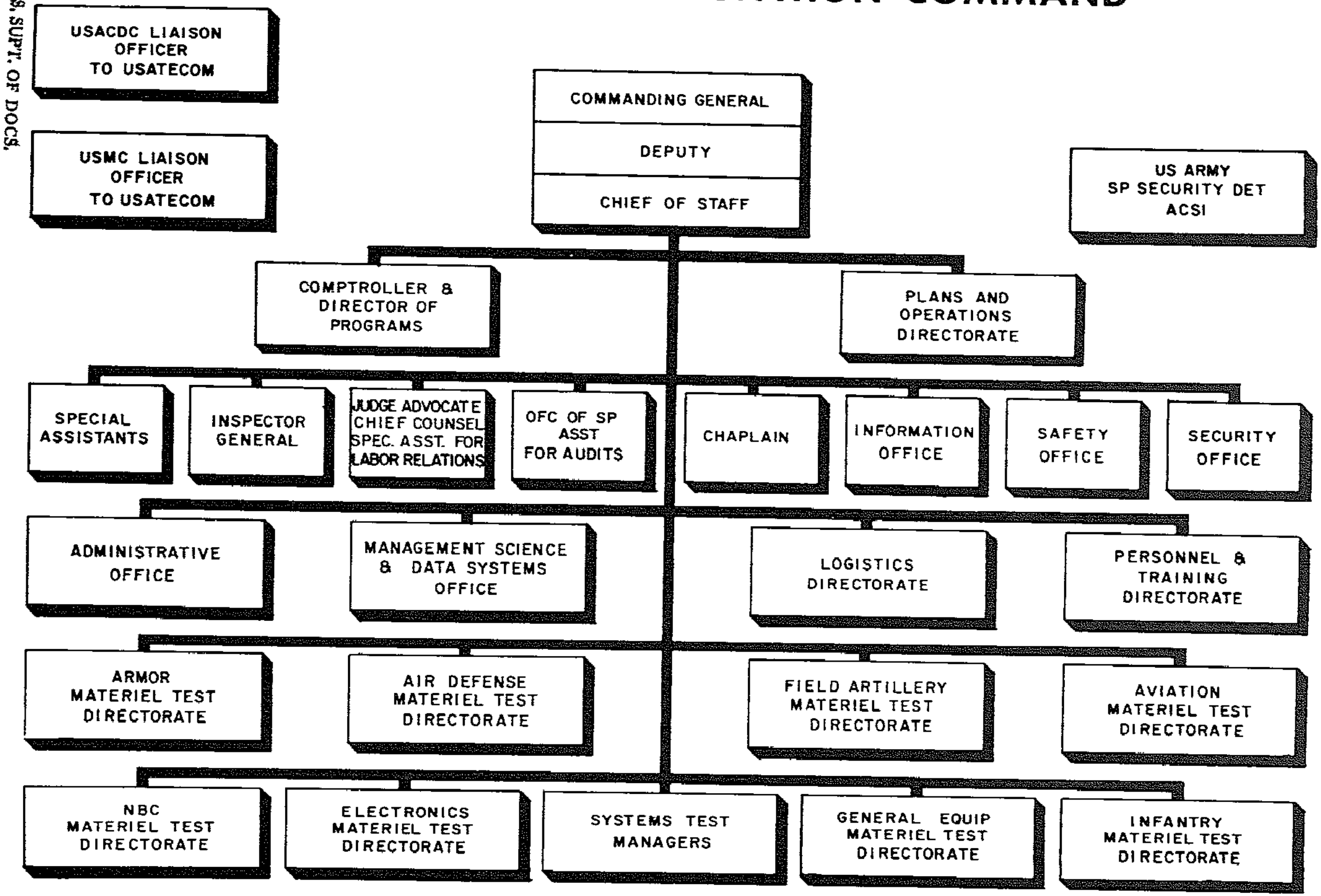
The Army's repertoire of official tests—currently, about a score in number—is associated with all phases in the life cycle of Army materiel. Within TECOM they fall into two broad categories.

In one group are the engineering and service tests performed as part of its basic mission. In these instances, test plans, test reports and other details are the primary responsibility of TECOM. Test results, produced by independent test and evaluation, are furnished to AMC for use in making decisions respecting type classification. Included in this category are initial production tests which are, essentially, re-tests run to determine that deficiencies detected during service testing have been corrected, that modifications resulting in the change from research and development to production are acceptable, and to provide a

Benjamin S. Goodwin has been Special Assistant and Technical Advisor to the Commander, Army Test and Evaluation Command, since 1962. Prior to assuming this position, he served for 12 years as an engineer with Aberdeen Proving Ground's Development and Proof Services. Mr. Goodwin holds a B.S. degree in mechanical engineering from Georgia Institute of Technology.

PROVISIONAL

HEADQUARTERS U.S. ARMY TEST & EVALUATION COMMAND



basis for determining the suitability of test items for final type classification.

In the second group of tests staged by TECOM are those performed as a service for commodity commands, project managers, Army contractors and manufacturers, the other Services, and other authorized agencies. Examples are feasibility, engineer design, and military potential tests connected with research and development, initial production and confirmatory type tests conducted during the production phase, and product improvement and surveillance tests in the operational phase. Under these circumstances, the "customer" prescribes test plans and objectives, establishes procedures for processing and distributing reports, and foots the bill. More than half of the TECOM workload is concerned with this type of testing.

Early Planning and Programming

Test planning and programming is started as early as possible in the development process to ensure maximum efficient use of all available information. The first step taken is the preparation of a Coordinated Test Program (CTP). This plan is a responsibility of the developer with input from TECOM.

Basically, the CTP functions as a schedule for development and testing purposes. It specifies whether an integrated, concurrent, or sequential test program will be followed, and establishes test objectives and outlines test schedules. It also establishes the number of prototypes required, the environmental testing deemed necessary, plus the funds and test support that will be required.

CTP annexes provide additional guidance to assist test planners. All background on the project is included in the CTP, together with a comprehensive description of the materiel and available photographs and drawings. Special support requirements outline anticipated need for unusual test facilities, instrumentation, specialized test equipment, manpower, transport, and contractor assistance. Not uncommonly, such requirements touch off significant construction and training programs, as well as extensive research and development in the fields of instrumentation and methodology.

TECOM installations and activities usually commence planning when test directives are issued by the headquarters. These directives are the signal for preparation of test plans by each TECOM agency concerned. When approved by the cognizant materiel test directorate of TECOM headquarters (for service tests by the Combat Developments Command), the test plan provides detailed guidance for conducting the prescribed test.

Engineering tests are conducted at four proving grounds; by the General Equipment Test Activity at Fort Lee, Va.; and by White Sands Missile Range, the national range operated by TECOM near Las Cruces, N.M.

The objective of the engineering test is to determine the technical performance and safety characteristics of an item or system and its associated tools and test equipment, as decribed in the pertinent QMR. It is characterized by controlled conditions and the elimination of human errors in judgment, so far as possible. Engineering tests are performed through the use of environmental chambers, physical measurement techniques, statistical methodology, personnel trained in engineering and scientific fields, and controlled laboratory, shop and field trials. Data is provided by these tests for use in development and for determinations regarding the technical and maintenance suitability of materiel for service test.

Items slated for engineering tests usually are assigned to TECOM test activities at:

- **Aberdeen Proving Ground**—Artillery, ammunition, infantry and aircraft weapons, wheeled and tracked vehicles, armor, and electronic control and guidance systems.
- **White Sands Missile Range**—Missiles, rockets, and similar devices.
- **Electronic Proving Ground**—Electronic equipment and systems, communications items, surveillance instruments, and devices to disrupt enemy communications.
- **Deseret Test Center**—Chemical, biological and radiological munitions; and agents and defense systems for evaluation at Dugway Proving Ground.
- **Jefferson Proving Ground**—Ammunition, fuzes, and mines.
- **General Equipment Test Activity**—Quartermaster and general purpose equipment not within the purview of other test activities.
- **Yuma Proving Ground**—Aerial delivery equipment.

Service tests, the primary responsibility of TECOM's service test boards, result in what are, essentially, user reports. They are aimed at determining to what degree the test item and its maintenance package meet the requirements of the QMR.

Using soldiers representative of those expected to operate and maintain the equipment in the field, the service test is and has been conducted with a minimum of instrumentation under simulated or actual field conditions. It is characterized by qualitative observations and judgments of military personnel who have a background of experience with the type of materiel under test.

Service test boards are assigned missions for testing materiel in the following categories:

- **Airborne, Electronics and Special Warfare Board**—Airborne equipment including aircraft, designed to facilitate air drop or air transport of troops, supplies and equipment; communications equipment, employed at the division level or below; combat surveillance and special warfare equipment.
- **Air Defense Board**—Air defense weapons, air defense electronics equipment and devices, target devices atomic demolition munitions.
- **Armor and Engineer Board**—Armor and engineer items, automotive systems and materiel, excluding certain engineer, quartermaster and transportation items.
- **Aviation Test Board**—Aircraft items, systems and related equipment
- **Infantry Board**—Weapons and other items used by infantry units for target acquisition, ground surveillance, fire control and ground mobility; field-type clothing, equipment and rations for small units and individuals; anti-personnel mines; chemical and biological warfare equipment for small units and individuals clothing and equipment for parachutists.
- **Field Artillery Board**—Field artillery, guided missiles and related materiel.

Since most military equipment today is designed for world-wide use the total test package usually include provisions for subjecting materiel t the extreme natural environments i which they are expected to operate Three environmental test centers a maintained by TECOM to meet these purposes.

Desert environmental tests are conducted at Yuma Proving Ground in Arizona. Here, approximately a million acres of arid wasteland are available for wringing out Army equipment in the dry, dusty terrain of the American Southwest. About 40 percent of the area is hilly or mountainous; the remainder is generally flat desert pavement, sand plains, washes and bottomland, all deadly adversaries of man and his machines. The proving ground mission includes tests of air delivery equipment and air delivery tests.

In sharp contrast are TECOM's operations in the humid tropical environment of Panama where the Tropic Test Center is headquartered at Fort Clayton in the Canal Zone. Combined with dense tropical undergrowth, the mud, heat and humidity of the jungle test sites offer a continuing challenge to the soldier and the equipment he must operate and maintain under these conditions.

TECOM's cold-weather test missions are assigned to the Arctic Test Center at Fort Greely, Alaska. Located less than 180 miles below the Arctic Circle, the center "enjoys" some of the worst conditions the long, cold Alaskan winters can offer. The extreme cold of the test season, combined with the chilling winds and drifting snows, makes for an ideal test climate. As with most materiel tested in environmental extremes, much emphasis is placed on determining the compatability of the soldier and his equipment, as well as surfacing shortcomings and deficiencies in the materiel itself.

While mobility is an intangible quality of Army materiel, it is a subject of keen interest to the General Equipment Test Activity (GETA). In addition to its basic responsibility for testing general use items, rail and marine equipment and non-tactical and commercial vehicles, the command routinely reports on the suitability of materiel for use in logistics-over-the-shore (LOTS) operations, its adaptability for movement and delivery by all modes of transportation (MOVAD), and its cargo loading adaptability.

LOTS operations are concerned with the loading and unloading of ships over unimproved shore lines and through partially destroyed port facilities. To be considered for use in operations of this type, vehicles must be able to move from landing craft and other vessels to the beach and then proceed to points at least two miles inland.

Amphibious vehicles are expected to reach the inland areas under their own power from points five miles off shore. Those classed as "non-swimmers" need only be capable of negotiating a fordable surf after being debarked from beached landing craft.

MOVAD trials are conducted by GETA to determine the transportability of materiel in service-ready condition by rail, water, highway and air. Standard tests include observing and inspecting items and components under actual movement conditions. During these evaluations, consideration is given to such things as the adequacy of lifting devices, tie-down provisions, hazardous and unusual characteristics, ground clearances and angles of break, approach and departure in relation to movements into, on and off various means of transport.

Cargo loading adaptability trials are conducted to determine the classes and mixtures of military cargo that can be loaded on or unloaded from the test item. Limitations of materials handling equipment and similar difficulties are noted during these investigations.

In practice, appropriate classes and mixtures of military cargoes make up the test loads. Available materials handling equipment of types organic to port, depot and terminal organizations, as well as research and development prototypes, are used for loading and unloading. Various loading patterns are accomplished from shipside, ground level, warehouse docks, rail cars and other vehicles.

GETA also performs certain line haul evaluations to determine the suitability of test items for use as troop and logistical carriers in theaters of operations.

In these evaluations, test and comparison vehicles cover a minimum of 1,000 miles, 50 percent by highway, 30 percent by secondary roads, and 20 percent over cross-country terrain. Half the mileage is logged with vehicles loaded to rated capacity; the other half is traversed with unloaded vehicles.

Records of operating costs are maintained throughout line haul evaluations. These include total mileage and data on fuel, oil, grease and repair parts, plus maintenance requirements. Fuel consumption in payload ton-miles per gallon and cost per ton-mile of operation is closely observed.

Test Evaluation Documentation

As might be surmised, documentation of the test function is on the elaborate side—and rightly so.

Test plans prepared by TECOM test activities, for instance, prescribe in considerable detail the functional and environmental techniques and procedures to be followed. They are shaped to meet the standards and objectives stated in applicable portions of the TECOM Materiel Test Procedures, test directives, QMRs, SDRs, and technical characteristics data.

The documentary products of testing consist of less than a dozen standard test reports serving a variety of purposes. Of these, the Equipment Performance Report and the Final Test Report are typical.

- Equipment Performance Reports are issued by test agencies as a rapid means of informing commodity commands, project managers and others concerned when specific failures, malfunctions, or deficiencies crop up in equipment being tested. The reports identify failed components, briefly describe the conditions under which they failed and, sometimes, suggest redesign action.
- Final Test Report is the formal report rendered by testing agencies upon completion of testing. It contains the conclusions and recommendations of the test activity and describes in detail the test purposes, procedures followed, and results obtained. TECOM recommendations regarding the suitability of materiel for Army use, further development, or other action are based on this report. Generally speaking, AMC decisions on type classification are also shaped by the Final Test Report.

Testing, of course, is not an end in itself. Neither is it a dispensable step in the logistics system as we know it today. Too much is at stake.

By any standard of comparison, the AMC logistics mission, in which TECOM now plays a critical role, is a task of herculean proportions. From its arsenals, depots, shops, procurement centers and other supply sources, AMC supplies the combat forces with a measured mix of basic necessities—food, clothing, shelter—as well as the munitions of war. In addition, it must provide *now* for the needs of tomorrow's soldier by devel-

(Continued on Page 23)

Evolution of DSA Procurement Quality Assurance

George G. Gul

The rapid advance of technological progress from the decade of 1950 through 1960, particularly in the missile, aerospace and nuclear propulsion programs, has also advanced Defense Supply Agency (DSA) quality assurance concepts from "go" "no go" inspection to a system concept of quality assurance. Recognizing the sophistication of weaponry, DSA requires contractors to design and maintain a quality control program to assure compliance with requirements of the contract.

The Procurement Quality Assurance Program (PQAP) is administered by the Defense Contract Administration Services (DCAS) Quality Assurance Directorate of the Defense Supply Agency.

Procurement Quality Assurance Program

In this present state of metamorphosis, the system concept is a program of interrelated elements performed by quality assurance personnel to assure that contractual requirements have, in fact, been complied with by the contractor prior to acceptance of the product. A contractor's quality program, to be effective, must be documented and must include control of all work operations and manufacturing processes, as well as inspections and tests. It should be emphasized that the interrelated elements of the DCAS Procurement Quality Assurance Program provides indicators or sensors of the contractor's quality control program and the product's conformance to specification requirements. Successful results in the form of good product quality can be assured by effective and systematic implementation of five elements of PQAP:

- **Procedures Review.** Written procedures are generated by the contractor to document quality or inspection method. A review is made of these procedures for conformance and to assure that they adequately specify manufacturing techniques, controls, and inspections. The review is conducted prior to start of production. In addition, during the review, a checklist is developed to use during production for continuing evaluation of procedures in operation.
- **Procedures Evaluation.** Satisfactory procedures review leads directly to procedures evaluation as contractor production progresses. Procedures evaluation, in essence, assures that the contractor follows his written procedures. Prove-out is accomplished as early as possible throughout the entire manufacturing cycle to verify the completeness and adequacy of the contractor's procedures in operation. An incidental benefit is assurance that contractor adherence to the procedures results in delivery of quality products, manufactured to contract requirements. Checklists, developed during procedures review, are used in subsequent evaluations to ensure maintenance of satisfactory quality and process controls; thus, assurance is provided that the contractor's manufacturing processes and inspections remain in accordance with written procedures, thereby maintaining quality control.
- **Product Inspection and Test.** Direct inspection of product characteristics, in-process and end item, is performed for product acceptance, verification of product quality, and adequacy of the contractor's quality controls. Inspection is performed to the degree necessary to assure contractor compliance to related contractual requirements.
- **Contractor Decision Verification.** Contractor decision verification is the direct inspection of product characteristics, not covered during product inspection and test but subsequent to contractor inspection using contractor's inspection records, to determine and verify the accuracy of contractor quality and inspection decisions. Using a checklist, prepared earlier, designated product characteristics are inspected and results are compared to the contractor's inspection records o the same characteristics. Compara bility is an indication that the con tractor's inspection is effective.
- **Corrective Action.** Last but nc least is corrective action. It is an es sential element of any program. It i required of the contractor when an breakdown in his quality prograi occurs to assure that product qualit is not compromised. In addition, it er sures that the correction precludes re currence. Corrective action is applie to any of the elements of the DCA Procurement Quality Assurance Pr gram.

Operating procedures are develope to form the basis of continuin quality assurance functions. Th procedures cover criteria for estal lishing the initial magnitude and fre quency of continuing procedures eva uation, product inspection and test and contractor decision verificatio Subsequent reduction or increase o effort in any PQAP element is base on past quality history, custome complaints, and confidence within the element, plus the effects of interre lating elements. Statistical qualit control is used to maintain the re quired control of quality. A statistica plan is developed for the operatin elements of PQAP. Statistical plar ning includes randomness, selection o characteristics, reduction and tigh ening of effort, review of contracto records, frequency, acceptable qualit level, process average, etc.

Level of PQAP Application

In establishing the level of PQA application, a definite relationship recognized between the commodit being produced and the contr system. The more complex the com modity, the more complex the a signed control system and the great the number and importance of el ments to be evaluated. Manageme controls over PQAP are maintain by a management information syste The information system provides t

means for measuring PQAP effectiveness, as well as PQAP application.

This shift in quality assurance concepts has established the need for engineering capability in the DCAS Quality Assurance Directorate. As defense procurement patterns shift to still more sophisticated weapon systems, engineering qualifications in DCAS become critically important for accomplishing requirements established by buying activities. Future progress in space and defense programs depends on understanding and developing new materials and production methods. Modern electronic weapon and space systems, integrated circuits and other microelectronic items, whisker metallurgy (composites), laser beam welding, and other technological developments require high quality/reliability engineering competence to administer DCAS quality assurance programs. In many instances, normal controls over manufacturing processes and techniques are inadequate to assure that material of the required high standards of uniformity and reliability can be produced. Also, in a significant number of cases inspection requirements, as outlined in various military specifications, may not be sufficiently searching in character to assure that the necessary degree of perfection can be reliably achieved.

The level of quality and the effort needed to attain this perfection should be related closely to the fulfillment of the need. It is increasingly evident that we will find a growing need for optional provisions or addition to our specifications relating to specific contracts, which may result in establishment of more than one level of quality and intensity of inspection for some of our semi-finished or component products (Group B, C and D performance tests may be cited as examples). Achievement of this concept requires the exercise of engineering judgment on the part of the specification writer, the requiring activity, and the contract administration service, with close liaison among all three. Frequently the specification writer is remote from actual physical contact with the material for which he is specifying standards. Refinement of specifications is, therefore, almost completely dependent on the extent of communications to the specification writer from the end user who tells how well the product design meets the service need, and from quality personnel who judge the adequacy of the quality provisions in the specification.

The increased complexity of quality assurance functions have also been given substance in changes to the Armed Services Procurement Regulation (ASPR). ASPR 1-406 now prescribes certain engineering functions as normal DCAS performance. The introduction of engineering skills recognizes the increasing complexity of today's materials, equipment, and production processes. Engineering expertise is now essential in establishing and maintaining an effective quality assurance program for defense mission. At least six characteristics of today's defense procurements demand a heavy reliance on engineering capability. These are:

- Highly technical nature of many contracts.
- Lack of definitive quality requirements.
- Necessity for complex tests.
- Dependence on simulation and simulation methods.
- Compression of schedules and available time.
- Sophistication of weaponry tending to increase performance type contracts.

These characteristics reflect a significant advance in technology, and, consequently, affect quality assurance methods and concepts. Noting the shift in defense procurement patterns, DCAS has increased its engineering capability by 100 percent from its inception in January 1966.

In addition, the quality assurance management system continues to increase its reliance upon scientific management techniques. This is readily apparent in computer use, data feedback systems, communication networks, work measurement programs, and general use of engineering and operations research techniques. In order for the quality assurance program to keep abreast of these developments, the necessary professional skills with respect to both hardware and management systems are essential and must be present in the quality assurance organization. The introducton of engineering and special technical skills does not imply a change in the quality assurance mission or policy, but rather it should be noted that the function has grown quite complex and these skills are provided to increase the effectiveness and scope of operation of quality assurance.

The yesterday and today era of defense procurement quality assurance has shown the increased qualifications required by DCAS to accomplish this function. What can we expect in the future? What are the trends in commodities and technology? Which trends affect work force requirements? What will be the work force skills?

Tomorrow—Automation and New Technologies

Major advancements have been made in automation and development of new materials, processes, and testing techniques. The commodities of the future will be built automatically under extremely controlled conditions. New, more sophisticated numerically controlled machines will be developed for many of the commodities now requiring craft skills. This trend will continue as labor costs increase.

Computers will link the design phase directly with the production process. Today's concept of design/drawing/release/manufacturing cycles will no longer exist. With the tremendous growth predicted in technology, the engineer's role in controlling quality will be critically impor-

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tant. Less often will industry or the Government be able to place men in production lines to catch specification errors while the product is being manufactured. We must apply engineering talent *before* automated equipment is put into operation. End of line or complete item inspection will be impossible or too late. The item will be encapsulated, as in integrated circuits, or too far in production process for economical rework as in electron beam welding at 100 inches per minute fusion rate for ½-inch thick stainless steel plates.

Quality and design engineers will program the design into the computer with instructions for numerically controlled machinery. The computer will direct the operation of manufacturing processes, such as drilling, milling, boring, turning, assembly of microminiature components, or blending and compounding in the petroleum and chemical industry, etc. Quality assurance in the machine tool environment is normally performed by certifying with machine calibration during production at frequent intervals with a certified standard tape.

Figure 1 indicates the expected growth in the numerical control (N/C) machine tool area in industry. The statistics apply to the metalworking industry which utilizes numerically controlled lathes, boring machines, milling machines and other machines.

Many innovations in the numerical control field will provide for one system to operate as many as 256 individual machine tools (which may be of widely differing types) from the output of a single computer. Test equipment in this environment would be automatic and controlled by the computer. Equipment will be accepted by a review of computer controlled and printed test data.

The petroleum industry has been a pioneer in this field. The petroleum in-line blending system calls for blending six base stock components (platformate, alkylate, catalytic cracking, pentane, butane and combined raffinate and light). Also, the addition of anti-knock compound, two dyes, and two additives can be controlled to produce all of the gasoline production. Similar types of blending operation will be used for JP-4 and JP-5 jet fuels. Line analyzers with specially designed sensors analyze, print, and automatically control vapor pressure, octane number, API gravity, contamination, water content, and the like.

A project, sponsored by DCAS and selected oil refineries and pipeline carriers, is well underway to assure establishment of the proper quality assurance sampling techniques, acceptability standards, calibration, and controls of the automated in-line blending of JP-4 fuel. This concept most likely will revolutionize the present batch quality assurance techniques applied by the petroleum industry, with resultant savings in time, testing and manpower. Should this study prove that automated in-line blending is feasible, then present specifications, qualification procedures, American Society for Testing Material test methods and procedures, as well as procurement quality assurance provisions, will have to be revised to permit use of these new techniques. Foresight with objectivity is the motto, for myopic thinking during the study can be a deterrent to progress.

Electronic equipment will also be manufactured and tested under automated conditions. In-process controls and systems surveillance will be critical. Computers will sample plating techniques, etching processes, and control most machines involved in the production of microminiature chips, integrated circuits and thick and thin films. Again, acceptance will be by review of print-out test data as programmed by computer-controlled automatic test equipment. Toll gate inspection will be done with "go" "no go" tolerances by a computer programmed for acceptance or rejection. Product verification and visual inspection of today will become an item of historical significance. Product line certification will be the approach to accomplish the quality assurance mission.

Since quality cannot be adequately determined upon completion of the automated process, controls must be established and monitored during the production cycle. In future thin film (integrated circuit) manufacturing processes, parts will be welded together, moved through a heat treat operation, subjected to cleaning, processed through a plating line and, finally, packaged and identified for stock or shipment without benefit of stop-off points for product inspections. Throughout the production process, automatic process controls would be programmed so that the welding, plating, heat treatment and cleaning will be performed at proper temperature, strength monitored, time duration controlled, etc. In addition, automatic quality evaluations will be programmed to evaluate the quality of the weldment, plate, heat treatment, cleaning process, packaging, and design characteristics of the end item. Provisions will be for calibration of various sensors and evaluation of accuracy at predetermined frequency.

Already a study by the DCAS Quality Assurance Directorate and the National Aeronautics and Space Administration's Reliability and Quality Assurance Office is underway in product line certification for integrated circuit producers. The study will evaluate the manufacturer's ability to control his production processes; evaluate product test methods and results; and evaluate the detailed plan of how the product line will be maintained at its high-quality performance level. It is intended to expand the plan to other products.

Quality Engineering Knowledge and Skills Required

The days of the "old time" inspector are numbered. He will be re-

Numerical Control Machines in Use in Metalworking Industries*	Year
7,100	1965
10,000	1966
13,712	1967
14,943	1968
16,731	1969
18,750	1970
20,769	1971
22,766	1972
25,386	1973
28,006	1974
30,626	1975

***Source: *American Machinist*, November 18, 1968, for 1965-1968. Defense Contract Administration Quality Assurance Engineering Projection for 1969-1975.**

Figure 1.

placed by a more highly trained and technically competent individual. DCAS quality assurance personnel, assigned to plants or facilities with significant automated process, will be quality engineers. To advance with the technology, the quality engineer must be trained in computer systems and applications, as well as in process controls and systems evaluation and control. Greater emphasis will be required on specialized experience and training in these areas, in conjunction with essential commodity and engineering discipline knowledge.

Computer Technology.

The quality engineer must have a knowledge of computer language, computer memory (storage), sequential (step by step) operations, and stored programs. Fortran or modified Fortran programming will be a prime technical tool of the quality engineer, since it can perform both arithmetic as well as mathematical operations, and can be programmed for manufacturing process control as well as scientific or engineering design and problem solving. The quality engineer will review the program to ensure it contains proper controls, tests, sensing devices, frequency of checks, control limits, and corrective action, and that process variables, etc., have been adequately programmed into the automated engineering process to assure quality and reliability of end items.

Process Engineering.

The quality engineer must have a good knowledge of process engneering to enable him to determine whether or not a manufacturing process includes necessary monitoring and control modes and to assure that proper alarms, restraints, or corrections have been programmed into the computer. In addition to knowledge of processing engineering, the quality engineer must acquire knowledge and experience in programmed control system feedback and corrective action. Corrective action may be automatic or an alarm system which signals need for manual adjustment or correction to bring the process within control limits. In addition, with visual presentation or printout of data, the quality engineer must be able to review raw data and computer output to detect when combination of controlled functions approach an "out of process control" condition. Then the engineer must be able to take action to assure the product is verified as being satisfactory. Process monitoring requires that the computer be programmed to establish:

- Status of Equipment. The computer will be programmed to monitor the status of various sensors and equipment, such as pumps, valves, motors, switches, interlocks, etc., in the processing system. Thus, safety conditions will be established to eliminate possible unwanted combinations of valve settings, interlocks, etc., and assure proper blending, compounding, machining, etc., of the end item. The computer also will be programmed to monitor flow, temperature and pressure measurements as well as wear of components, overheating, and excessive vibration of the equipment. In addition, leaks, such as steam, water, air, etc., in process equipment can also be programmed and monitored by the computer.
- Instruments and Process Variable Monitoring. The computer will be programmed to scan the various process sensing instruments. The program will do the scanning on a fixed frequency, or on demand by the operator, programmed conditions, or as required by the process itself. During the scanning process, the computer will perform various checks, such as proper instrument functioning, detecting controller failures, interpreting erratic readings by programming limits into the computer, and comparing the readings against these limits. These limits will differ from out-of-range (unusable) limits. In addition, cross-referencing will be programmed so that readings are cross checked with other readings, such as flow and pressure, which normally are interrelated.
- Product Status. The monitoring of instruments and process variables will be critical in an atuomated operation, since the data will be the only method available to determine in-process product quality prior to end item evaluation. The computer will receive quality data from testing stations in the test laboratory. Computations will be performed on raw data developed by various analytical devices, such as chromatographs, spectrometers, mass spectrometers, calorimeters, etc., to derive product information and compare with program standards. This will be the means by which quality engineers determine acceptable, usuable, or reworkable end items.

Statistical Concepts.

Different statistical concepts must be applied by the quality engineer in the various automated manufacturing processes for analyzing and interpreting test data, as well as control of the process. The normal inspection pattern of accept or reject may be applicable in certain processes; however, concepts will have to be developed and applied for making valid determinations of acceptable, unusable, or reworkable end items and then programmed into the computer. Determination of the limits and the programming into the computer will require the application of new statistical techniques, as well as unique application of standard techniques. The statistical applications will be:

- Standard Statistical Techniques. Application of standard statistical techniques will be used and programmed; however, the techniques will be used predominately to project average performance from a sample; to compare materials or products with average performance; to compare materials or products with respect to variability of performance; and to determine number of measurements required to establish the mean with prescribed accuracy. Uniqueness will be in the application of various standard techniques in programming the computer to act as the "inspector"

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in determining and maintaining control of the automated process.

• Enumerative and Classificatory Data. The simplest kind of classification, and the one most widely used in practice, is where results of the test on each item are recorded as pass or fail, larger than specification limit or less then specification limit, etc. Classification by size, color and structure, however, require three or more categories. For example, in classifying types of metal fractures, classes may be established as smooth, rough, jagged, etc.; glass or plastic material after exposure to radiation may be classified as transparent, translucent, or opaque. In the screening inspection mode of automated processes, we will have three established categories: acceptable, unusable, or reworkable. The Chi-Square Test of statistical concepts *can be used to determine* whether there has been a production process "shift" by comparing the data *generated by a given quantity of* material with a programmed standard (known distribution of previous material). The *computer would indicate* that further analysis is required to determine the cause of the "shift." Statistical analysis of tolerances would be programmed and used to determine whether a particular item (or range of items) should be reworked, scrapped, or considered usable.

• Comparative Experiments. In many industrial processes, there is a measurable end property whose value is of primary interest and which should attain some optimum value. This end property is known as yield or response. For example the end property might be strength, or some chemical or physical characteristic that would be most desirable at a maximum or at a minimum. Naturally, the value of this primary end property will depend upon the values of the factors in the process which affect the end property. These values will be developed and programmed into the computer to control the optimum response or output of the process. In addition, the amount of change in response that results from small deviations from optimum settings will also be developed and programmed. Thus, process control limits will be established. By use of the factorial experiment statistical concept, a chemical process, wherein time, temperature, pressure, amount of catalyst, purity of ingredients, etc., are the controlling factors, will be programmed for establishing the values of the variable factors to obtain optimum response as well as the allowable deviation from optimum for control of process.

• Non-Standard Statistical Techniques. In an automated process, short-cut tests will be programmed for "quick and dirty" checks. Typical queries to the computer will be: Does the average of the new product differ from the standard? Does the average of the new product exceed the standard? Is the average of the new product less than the standard? Typical application of short-cut tests will be, for example, in the transistor area of "reverse bias collector current" of an automated production process, wherein the actual and running average is compared continuously with established standards as to conformance, exceed, or less than the standard. The Sign and Wilcoxon—Signed Ranks Test illustrates this concept and will be programmed into the computer. In addition, comparison type tests may be programmed to determine the comparability of two different manufactured transistors of same type designation.

As computer techniques become more sophisticated in their applications in the manufacturing process, statistical techniques utilized in conjunction with the computer will also become more sophisticated. Future statistical techniques will tend to be refinements of present day statistical tests, such as Chi-Square, Student's "t", Kolmogorov-Smirnov (k-s), etc.; and other high powered statistical techniques, such as, math-modding analysis of tolerances, design of experiments, etc. Thus, presently unmeasurable quantities can be computed by the computer from other variables which can be measured. This is known as indirect or inferential measurement, and requires equations which relate the desired unmeasurable variables to available measured quantities.

Instrumentation Concepts.

The quality engineer must have knowledge and experience in computer instrumentation concepts. Instrumentation of an automated process is critical. Monitoring, testing, and controls of the process are based on the various sensing devices used throughout the process. Prior to the advent of the computer, most instrumentation was of direct reading type (pressure gauge, voltmeter) requiring only the calibration of the instrument. A process measurement for input to a control computer requires a transducer, a means of transmission to the computer, and conversion to computer language for final sorting and use by the computer either as a visual presentation, printout, or comparison with specified limits.

• Transducer Technology. Transducer technology involves the selection and application of suitable devices for sensing some physical property critical to the process monitored. The transducer is a sensing element that receives energy from the medium monitored. The sensing element may be thermal, mechanical, pneumatic, electrical, or acoustic, depending upon the medium and measurement to be monitored. Output of the transducer must be converted or amplified to a suitable form and level to be fed into the computer. Thus the quality engineer must possess knowledge of and experience with numerous sensing devices, conversion means, and amplifying circuits such as thermo-couples, Bordon tubes, analog to digital conversion devices, differential amplifiers, etc.

• Error Analysis. The quality engineer must have a knowledge of error analysis. This is necessary for calibration purposes. Errors may be categorized as equipment error, transmission error and human error. Equipment error will be in the sensor, conversion and amplifying devices as well as in the computer system (input devices, recorder, arithmetic or mathematical unit). A sensor extracts some energy from a measured medium. The measured quantity is disturbed by the act of measurement, making a perfect measurement impossible; thus, error is induced in the measurement. Transmission error must also be considered and is normally found in two areas: noise interference and transmission line impedance losses (resistance, capacitance, inductance). In addition, consideration must be given to time of transmission, even though in nanoseconds, from sensor activation to computer evaluation. This is essential for control purposes, otherwise reworkable or unusable material may result. Last but not least, consideration must

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FROM THE SPEAKERS ROSTRUM

Steps To Improve Weapon Acquisition Process

Charles L. Poor is acting Assistant Secretary of the Army (Research and Development). Prior to his nomination, he served as Deputy Assistant Secretary in the same office. Secretary Poor has been a career scientist since 1945, when he joined the Ballistic Research Laboratories, Aberdeen Proving Ground, Md. He holds an A.B. degree in aeronautical engineering from Harvard University.

Address by Charles L. Poor, Acting Asst. Secretary of the Army (Research & Development), before the Pittsburgh Chapter of the American Ordnance Assn., June 25, 1969.

The Defense Department, its laboratories and its contractors have been coming under increasingly severe public scrutiny in the acquisition of new weapon systems. We are told each day in the press of some new evidence of allegedly uncontrolled overruns in the cost of new weapons and vehicles for our Armed Forces, and there are dark rumblings about vast unearned profits and drastic deficiencies in the products we are giving our troops. It seems, therefore, appropriate to spend some time talking about the weapon systems acquisition process, to discuss with you the roles of Government and industry as they work to provide for our taxpayers the things we need for our defense.

The role of the research and development management offices in DOD and the Services is, first and foremost, to provide for the citizens of the nation the opportunity to obtain, promptly, those weapons and equipments best suited to the needs of national defense. I stress the word opportunity. It does not make sense to build up arsenals of expensive equipments beyond our real needs. Our inventiveness, our wealth of industrial capabilities, and our competitive system of free enterprise, together with the fruits of an exploding science-based technology, give to the Services a vast number of attractive proposals for development.

But it is clear that we cannot reasonably attempt to carry through to development and deployment all the attractive schemes for new systems. Just because a very difficult, expensive, challenging project seems possible, and many (or some) people badly want to do it, is not, in itself, a sufficient reason for its undertaking. There has to be a better reason for allocation of national resources.

Develop the Research Base

So, one of the first jobs of the Director, Defense Research and Engineering, and of the research and development management groups of the Military Services, is to nurture the research base that keeps the new ideas flowing and to carry them far enough to decide, rationally, if it makes sense to go further. In doing this it is inevitable that many ideas get carried part way through development, and then are dropped or set aside because the capability offered is not worth the cost, or because a better, new idea comes forward that allows a simpler way of meeting the military threat. When we go too far with a development that is too expensive for us to afford to buy in the quantities needed for the military job to be done, we have wasted resources. When we fail to carry a proposal far enough to permit a realistic assessment of its military potential, we may have missed an important opportunity to save money, and human lives, and human effort, through new technology.

In this business of initial choice, I think the record is fairly good. We have started many projects that we have stopped early in the development cycle, because it had become clear that they could not sensibly claim the resources required for deployment. None of the ABM deployment proposals of the early 1960s could meet the test of economic reasonableness or of cost-effectiveness. The continuing research program in ABM technology did lead us to today's situation, where we know how to build a system that will work against many of the threats we see. We can today seriously and sensibly propose a significant improvement in our strategic posture, at a cost we can well afford. We can build with this technology a set of defense options to counter newly evolving threats—options which can safeguard our country and which offer the hope of slowing the offensive arms race through substituting defense for the unhappy alternative of further proliferation of strategic offensive forces to counter growth in enemy offensive capabilities.

The list of technical advances is long, and one of which both DOD and American industry can be justly proud. The military capabilities these advances offer are impressive and, prudently chosen and carefully devel-

oped, should lead to the kind of security through strength and technical excellence we owe the nation.

The Cost Problem

Nevertheless, there is a developing concern in the Congress, in the press, and in the minds of the public at large about our stewardship. We are reminded of cost overruns on major weapon system procurement, with example after example of systems whose cost exceeded by large amounts the initial estimates. We see, at the same time, many examples of loss incurred by defense contractors on projects thought to be well defined. It seems apparent that something is amiss—that our methods of doing business need to be re-examined and refined.

History is sometimes helpful in gaining perspective. The weapon designers and producers of the 1950s were almost completely preoccupied with the problem of performance. The Harvard Weapons Acquisition Research Project in 1962 studied 12 major systems, including Atlas, Polaris, Nike, B-58, and F-105. They concluded that, on the average, performance exceeded original predictions. However, performance was achieved at the expense of the other two objectives of the acquisition process. Actual development time averaged 36 percent greater than predictions and cost increased an average of over 200 percent and, in some cases, as much as 7 times original estimates. It seems clear that, if we are willing to spend enough time and money, we can solve almost any technologi- ·al problem. A current example is the .pollo program. The application of ırge amounts of resources to the specific problems of landing a man on the ıoon has resulted in the solution of ·emendous technical problems much ıore rapidly than most people a very ȝw years ago would have believed ssible. Even the program's severest tics must admit that it has been an ɫstanding technical achievement. wever, they ask the question, "Is it rth the cost?"

ȝecretary McNamara asked the ne question about the weapon sysıs of the 1950s—when he be-ːame Secretary of Defense in 1961. ere have been periods when the nanal defense has been so critical t, to use a time-honored ːhe, "money was no object." World War II was such a period. There may again be times the country must spend whatever is necessary to assure success.

The same thing can be said for certain specific weapon systems. The invention of the bow and arrow made it impossible to survive using clubs. After gunpowder became available, a nation could no longer survive by relying solely on bows and arrows. It was considered absolutely essential that this country develop the atomic bomb, regardless of cost. The ballistic missile and Polaris submarine *may be* in the same category. However, weapon systems of this importance do not come along very often. This philosophy was being applied to too many of our weapon systems in the 1950s and this caused a reassessment of our acquisition process.

Some of the things we did in the early 1960s to correct this were:

- Costs were made equal in importance to performance and schedule in the normal program, as a matter of policy.
- Elimination of "gold plating" was made a policy goal.
- Increase in competition was made a policy goal.
- Reduction in the use of cost-type contracts, particularly cost-plus-fixed-fee, was made a policy goal.
- Concept formulation and contract definition procedures were established.
- A broad range of system analysis studies to aid the decision-making process was established.

In the current review of the acquisition process, we have seen some results of the changes instituted in the post-1961 era. A recent review of seven major weapon systems programs indicates that while final costs will exceed initial cost estimates, the increases are dramatically less than in the 1950s. The average increase is less than 40 percent of the 1950 experience. While this is encouraging progress, there is clearly more to be *done.*

Although the concept formulation and contract definition procedure have not produced all the results we hoped for, they have contributed significantly to improving the acquisition process.

Purpose of Concept Formulation

The real purpose of concept formulation is to assure the following before starting contract definition:

- The mission and performance envelopes have been defined.
- A thorough tradeoff analysis has been made.
- The best technical approaches have been selected.
- Primarily engineering rather than experimental effort is required in the remainder of the program and that the technology needed is sufficiently in hand.
- The cost effectiveness of the proposed item has been determined to be favorable in relationship to the cost effectiveness of competing items on a DOD-wide basis.
- Cost and schedule estimates are creditable and acceptable.

The purpose of contract definition is to:

- Verify that only engineering development remains ahead.
- Establish realistic and firm specifications, schedules, and cost estimates.
- Identify possible risk areas.
- Obtain a signed contract, preferably in the presence of competition and preferably on a firm-fixed-price basis.

As most of you know, all of these objectives have not been met in all of our concept formulation and contract definition projects. I believe that this was primarily because we relied too heavily on paper studies in place of testing hardware. You may remember one of the catch phrases of the early 1960s: "paper costs less than metal." Of course, this does not recognize that the results of paper studies are often less reliable than they appear. While it is true that cut-and-try methods unsupported by a rational plan can be very expensive, so can beginning full-scale engineering development on the basis of a paper plan without experimental resolution of the high-technical-risk elements in the program.

To many people "gold plating" means adding cost to an item without adding utility. A broader definition would include adding utility to an item, but not commensurate with the adding utility. A broader definition defense program. We have made substantial progress in the first area, but we have a little further to go in the second area.

Competition in the Defense Market Place

Competition has an important place 1 the weapon system acquisition proess just as it does in the civilian conomy. But, there are important ifferences in the competitive environ- nents of the defense and civilian conomies.

The first difference concerns the umber of customers. In the competi- on between Ford and Chevrolet iere are millions of customers. The ict that I might buy a Chevrolet is ot a major concern for Ford. Barng a catastrophic mistake in design, ie sales of a particular automobile ill not vary more than a few per- ntage points per year, thus, asiring the recovery of most, if not all, the investment. On the other hand, the defense economy the Defense epartment is generally the only cus- mer for a weapon system. Somemes there may be a civilian market r a related item or a foreign miliary market. However, these sec- ndary markets are not normally rge enough to justify undertaking evelopment of the weapon unless the efense Department buys it. If *the* istomer does not buy the product, ot only is there no profit but practi- lly all of the investment may be st. The all-or-nothing nature of the efense market has an important in- uence on the other major differences the two environments.

The second difference between e civilian and military competitive vironments is the time in the life cle of an item at which the competi- on occurs. Both Ford and Chevrolet ve automobiles in the dealers' show oms where the customer can slam e door, kick the tires, and test drive e actual item he will receive before makes a commitment to buy. For a jor weapon system, the military stomer is usually given a blueprint, artist's concept, and a long list of ecifications of the item the con- actor proposes to produce. Somenes he is shown an engine running a test stand and new transmission at will be used in his "car." Seldom these components hooked together o a protoype that the customer can it, and almost never is the military stomer able to test drive the actual m he will receive before he makes a nmitment to buy it. In one instance, have a hardware competition at end of production and, in the other, it is essentially a paper competition before development begins. Because of the sudden-death nature of the competition in the defense environment, there is reasonably strong motivation to be optimistic in predicting the performance capabilities of the paper item.

Because of these differences in the two competitive environments, the Defense Department must be careful in its approach to the acquisition of major weapons. The controls normally provided by the competitive process are no assurance of success.

Improving the Acquisition Process

I have said that things were not so good in the 1950s, and that they are much better in the 1960s. Now I would like to talk about some tentative ideas as to how we might make them even better in the 1970s. Several very competent groups have been studying the weapon system acquisition process, trying to devise ways of improving it. The Aerospace Industries Association (AIA) Technical Council and Procurement and Finance Committee published a report in November 1968 in which it identifies the difficult problems caused by "unknown unknowns" in research and development programs. A panel of the Industry Advisory Committee and a task force of the Defense Science Board are in the final stages of studies on this subject. Many of the following ideas came from discussions within these groups.

The problem that is receiving the most attention at the moment is "cost overruns." First, we must define what is meant by the term "cost-overrun." The press generally defines it as the difference between the initial cost estimate and the final actual cost of a program. Such a definition does not recognize the quite different elements making up the total price differential. The first element is the cost increase associated with the work specified in the original program and not attributable to inflation. The second is cost of additional work not included in the original program. The third is the increase resulting from inflation. In my opinion, only the first element of cost increase should be considered a cost-overrun.

Cost increases are not unique to weapons programs. They frequently occur in areas that we know much more about than we do in research and development projects, as anyone who has built a new house recently is probably well aware. However, since we may be talking about billions of dollars in defense programs, they are much more difficult to deal with.

During World War II we spent as much as 41.5 percent of our annual Gross National Product (GNP) on national defense. In the Korean War a little over 13 percent of the Gross National Product was devoted to national defense. In 1968, the figure was 9.1 percent. Although we are spending a relatively small percentage of the GNP for defense, we must consider not only what the country can *afford* to spend, but also what it is *willing* to spend. The prices of weapons have increased so much in the last two decades that we must face the very real possibility that we may price ourselves out of the market.

The M-48 tank cost $110,000. The estimated cost of the Main Battle Tank is in excess on one-half million. A conventional anti-tank round costs from $50 to $100. The Shillelagh costs over $2,000.

Even though the new weapons are much more effective than the old ones, we must recognize that we are competing with potential opponents in terms of numbers of items as well as quality of performance. The Main Battle Tank may be 10 times as effective as the M-48, but it cannot be in 10 places at the same time. With today's prices, we cannot expect, nor do we always need, a one-for-one replacement of the old weapons. However, there is a minimum number we can accept and we must be sure the total price for the inventory is not unacceptable.

What we must seek is to avoid, on the one hand, development of systems in which cost is so important a consideration that the benefit of advances in technology is denied our forces and, on the other hand, the evident danger of adding sophistication to obtain marginal increases in performance at a price we cannot afford. Design for maximum effectiveness within an overall system cost constraint should give the designer the freedom he needs to trade off numbers against sophistication.

One approach to obtaining better design solutions might be for the Government to specify, in advance, the maximum total price we feel is appropriate to pay for the capability of

meeting an expected threat with a new weapon system.

Within that total the designers would be free to seek a solution that would maximize the effectiveness, comparing large numbers of simple, inexpensive weapons against smaller numbers of more sosophisticated designs with higher unit effectiveness and higher unit costs.

To provide a better base for more accurate cost estimates and for management decisions, I recommend the scope of concept formulation be expanded to include sufficient hardware development and testing to resolve most of the technical risks before entering full-scale engineering development. If it is economically feasible, we should complete a competitive parallel development and testing program of prototypes by two or more contractors as a basis for selecting the development and production contractor.

A prototype testing program prior to entering engineering development should eliminate most of the "unknown unknowns" described by the AIA study and, in turn, should make the coupling of development and production into a single program less prone to difficulty than it is at the present time. As you know, our policy is, *other things being equal,* to award contracts to the lowest responsive bidder. Since there are usually at least two technically competent competitors for a major weapon system contract and it is the only game in town, there is considerable pressure to be low bidder. Under this pressure, the contractor must plan efficient application of manpower and facilities over the entire life of the contract, with minimum provision for unexpected difficulties. If an "unknown unknown" disrupts the schedule, serious cost overruns can be anticipated. Elimination of unknowns before we establish a firm production program seems essential to good planning, both for the Government and for our contractors.

To assure that we do not go too far too soon in major weapon programs, we should identify at the beginning of the program those things that are critical to each phase of the program. The contractor and project manager would be required to furnish proof of having accomplished each milestone to secure approval to proceed to the next phase of the program. It might even be practical to tie release of funds to the successful completion of key milestones. Such an arrangement would, of course, have to be adequately covered in the contractual arrangement. If the check points are established properly, we should be able to avoid premature production commitments, and the costs incurred, should the development program require significant changes in design.

Acquisition Review

The Deputy Secretary of Defense recently established a Defense Systems Acquisition Review Council within the Office of the Secretary of Defense to advise him of the status and readiness of each major system to proceed to the next phase of effort in its life cycle. The council will evaluate the status of each candidate system at three basic milestone points:

- When the sponsoring Service proposes to initiate contract definition.
- When it is desired to go from contract definition to full-scale development.
- When it is desired to transition from development to production.

The membership of the council will include the Director of Defense Research and Engineering, Assistant Secretary of Defense (Installations and Logistics), Assistant Secretary of Defense (Comptroller), and Assistant Secretary of Defense (Systems Analysis). The Director of Defense Research and Engineering will chair the council for the first two reviews and the Assistant Secretary of Defense (Installations and Logistics) will be chairman for the transition to production review. The Deputy Secretary of Defense specified that primary responsibility for the acquisition and management of major systems will remain with the individual Services.

In closing, let me emphasize that major improvements in the weapon systems acquisition process can only come about through close cooperation between Government and industry. Your advice is always welcome, and together we should be able to make a good system of procurement even better.

Needed: Transportation Engineering Standards

Address by Maj. Gen. Clarence J. Lang, USA, Commander, Military Traffic Management and Terminal Service, before the Cooperative Societies Luncheon, National Meeting on Transportation Engineering, American Society of Civil Engineers, Washington, D. C. July 24, 1969.

Being invited to address such a distinguished group of engineers is a real privilege indeed. I am aware of your many talents and accomplishments and I am mindful of my responsibility to present some thoughts worthy of your time and interest.

This is my first public appearance in Washington since assuming command of the Military Traffic Management and Terminal Service (MTMTS) in April this year. In preparing for this occasion, I consoled myself with the thought that whatever I say, I can't go wrong. After all, we are the customer and the customer is always right.

Actually though, we are customers of yours indirectly. You design and build transportation equipment and facilities for the commercial carriers, among others. We, in turn, use the equipment which in a sense makes us your customer, too. This is especially significant when one takes into account the fact that MTMTS is perhaps the world's largest purchaser of commercial transportation. While we do not actually spend the money, we do prescribe how it will be spent. This amounts to more than $2 billion a year.

Like all good shoppers, we try to get the most for our money, but price is not always the determining factor. Our job is to assure that all defense transportation requirements are met. Any genuine requirement must be met —at any cost—and we must do it within available resources. The critical test in the choice of modes or routes, then, is "will it get the job done?" Indispensable considerations in our business are deliveries at the right time, in the right place, in the right quantities, and in good usable condition. Any procurement failing to

meet any one of these criteria is no bargain. More than that, it is a waste of time and money.

The transportation we prescribe for use, therefore, is that which is best designed to meet these requirements most effectively and most efficiently. The cost is considered within this framework.

The objective of my comments today is not to exercise a customer's inalienable right to be demanding, but to explain some of our problems and encourage your help.

Single Manager Land Transportation

First, and before I discuss transportation engineering, I should like to tell you a little about our organization and why the transportation purchaser is interested in transportation engineering.

Responsibility for military transportation requirements is divided among three single manager transportation agencies. The Secretary of the Navy is the single manager for ocean transportation. The Secretary of the Air Force is the single manager for airlift service. The Secretary of the Army has single manager responsibility for military traffic, land transportation, and common-user ocean terminals in the continental United States.

MTMTS, as the single manager operating agency for the Secretary of the Army, has a wide variety of responsibilities which fall under the umbrella of transportation. They include arranging for movement of troops and their weapons, munitions and material; world-wide responsibility for the movement of military dependents and personal property (household goods, baggage and house trailers). They include responsibility for providing common-user ocean terminal service within the United States to all military components—the Army, Navy, Air Force, Marine Corps, Defense Supply Agency, and other elements of the Defense Department. They include administration of the DOD Highways for National Defense Program. They also include certain transportation engineering functions.

To perform these responsibilities and functions, the current MTMTS organization consists of two area commands and one subordinate agency:

- Eastern Area, located at Brooklyn, N.Y.
- Western Area, located at Oakland, Calif.
- Transportation Engineering Agency, located at Fort Eustis, Va.

MTMTS is somewhat unique in that it is the only DOD transportation single manager agency that is jointly staffed, and has on its staff Army, Navy, Air Force, and Marine Corps personnel. It has an authorized personnel strength of approximately 7,000, of which some 6,000 are civilian employees. About 600 personnel are stationed at the MTMTS headquarters, located at Nassif Building in Falls Church, Va., near Washington.

During FY 1968, we directed the spending of DOD transportation funds in excess of $2.2 billion. Of this, approximately $1.9 billion was for the shipment of material and the remainder was for the movement of personnel. During the same period, we outloaded 19.7 million measurement tons of cargo, of which 2.5 million measurement tons were ammunition.

Objective

In managing such a workload, we are guided by three primary objectives which are spelled out in the MTMTS charter:

- To eliminate duplication and overlapping of effort by and among the Military Departments, Defense Agencies and other DOD components.
- To improve the effectiveness and economy of transportation operations throughout the Defense Department.
- To ensure that the approved emergency and wartime transportation requirements of the Defense Department are met.

It is the second objective—improvement of the effectiveness and economy of Defense transportation operations —that I wish to emphasize today.

With few exceptions, in the continental United States we depend upon the commercial carriers for our strategic transportation requirements. So you see, as one of the largest purchasers of transportation, we have a vested interest in the economy, efficiency and quality of transportation: economy from the standpoint of serving the taxpayer's interest; efficiency from the standpoint of timely delivery to those who are serving our country and our freedom-loving allies throughout the world; and quality from the standpoint of safety, dependability, and superior service.

These are attributes that can be accomplished only insofar as they have been engineered into the total transportation plant. We, in MTMTS, are assigned the implementing responsibility for the DOD interest in land transportation. Our MTMTS mission, therefore, is not just a matter of land traffic management and the operation of military ocean terminals, but includes the transportation-oriented portion of transportation engineering.

We consider transportation engineering to be a most significant part of our mission. In our Transportation Engineering Agency at Fort Eustis, we make numerous studies through which we are constantly striving to increase the strategic and tactical mobility of the Army in the field. Our tools include the application of traffic engineering techniques, more accurate transportability criteria for research and development, and better transportation guidance. Simultaneously, the agency produces guides for accomplishing these objectives at reduced or the lowest acceptable costs. In terms of increased efficiency, increased effectiveness, and greater economy, unquestionably transportation engi-

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neering is the area where you strike "pay dirt."

Now, what is meant by transportation engineering? It seems that different people use the term, transportation engineering, to mean different things. All branches of professional engineers speak of transportation engineering. Universities offer much the same specialized courses, but also call them transportation engineering. One gets the impression the term is used to mean all things to all people. Maybe this is good, maybe this is as it should be.

However, if I may, I should like to raise this question: "Would it not be helpful if, by a joint effort of the interested technical societies such as are represented here today, there were developed some disciplines, some guidelines, and some objectives or targets to shoot at?"

With this thought in mind, let us examine the subject from the military transportation point of view and determine what transportation engineering means to us in the Defense Department.

Evolution of Need for Transportation Engineering

During World War II, the first Chief of Transportation, Department of the Army, learned that he had to do many things in order to provide effective transportation support, things that the construction agencies and commercial traffic people did *not* do. These included such things as estimating the capability of a given highway or highway network to support desired military operations. More specifically, he had to determine what were the limiting characteristics of the transportation systems. He had to find the answers to such questions as:

• What tonnage could be delivered over the highway or railroad network with normal maintenance?

• What were the size and weight imitations of our railroads and high-'ays for movement throughout the Inited States and also overseas?

• What was the relationship be-ween legal limitation and the scientific and safe limitations of existing bridges and highways?

• What were the working capacity and limitations of various ports and ocean terminals?

• What tonnage could be moved through them?

• What types of roads and railroads were required for efficient movement of peak loads which would be generated by various types of new military installations, industries and activities?

• What types of equipment were required for most effective operation on the transportation right-of-way available in foreign areas?

Since World War II, other transportation problems have challenged the Defense Department. These problems are the result of major changes which have taken place since that time in both *what* is to be shipped and the *techniques* for shipping. These changes include the great increase in the military arsenal of sensitive material such as missile guidance systems, major increases in the type and severity of hazardous materials, and the great increase in the use of *intermodal* transportation.

More specifically, as a user of transportation, we now have a greater need to know what are the critical environments inherent to each mode of transportation and related terminal operations. What shock and vibration forces are transmitted to the cargo during normal operations and during accidents? What are the heat, cold, humidity and atmospheric pressure variations due to normal weather as well as to equipment and operating practices? What are the critical physical and geometric limitations for intermodal transportation?

We know a lot about these environments and characteristics, but our knowledge is in little bits and pieces distributed among many people. The information has not been brought together as a reproducible performance standard that can be used to classify hazards, to design packaging, restraining and buffering techniques and devices. Such performance standards would also provide the basis for establishing test procedures. It was this need for such information during and after World War II that led to the development of a transportation engineering program in the Department of the Army. This need also led to a delineation of what we mean by transportation engineering, *i.e.*, different from "construction and maintenance engineering." Accordingly, the *Dictionary of U.S. Army Terms* includes the following definition of transportation engineering:

> **The science of evaluating the requirements for and planning the layout and functional aspects of transportation facilities; and of developing the most efficient relationships with respect to transportation equipment, transportation facilities, and traffic movement patterns so as to insure adequate, safe, and efficient movement by all modes of transportation.**

You will note this definition is ope ational or traffic engineering in cha acter. It pertains to the dynamic a environmental aspects of transport tion. It requires the identification a definition of the limitations of tran portation systems. It presents t need for establishment of transport bility criteria or transportation stan ards that are reproducible, and t development of tests to reproduce t environment in which things must li while being transported. It leads the identification of all unacceptab restraints to efficient and effecti transportation and planning syste development, so as to eliminate reduce them. It is bringing abo these relationships that will enab realization of maximum benefits fro all transportation systems to meet t needs of the national economy and t national defense.

Thus it can be said that transport tion engineering, as we in the DO know it, has to do with defining a improving the quality of transport tion and the effectiveness of t service the transportation systen provide.

As a result of the continuo stream of new problems and o World War II experience, a study transportation engineering in the D fense Department was made by t Military Services. The objective the study was to determine wh should be the role of transportati engineering in the Defense Depar ment and who should perform t functions.

The study was made with the fu participation of all the Military Ser ices. Agreement was reached at a levels. With respect to who shou perform the functions, the stu stated that the functions necessa for accomplishment of the objectiv are oriented to military materiel a transportation systems. It was t feeling of the study group that th provided the most logical and effecti foundation for organization with the Defense Department. Accordingl the *materiel-oriented functions* shou

› performed by the materiel development commands of each Military ›rvice for the materiel each is devel›ing. The *transportation-oriented nctions* should be performed for all ›rvices by each transportation single anager for the transportation sys›ms and related terminals for which ch has been assigned single man›er responsibility.

These single managers, as I have ready pointed out, are the Secretary the Army, the Secretary of the ›vy, and the Secretary of the Air ›rce. Very simply, it places respon›ility where the expertise is, and ovides for maximum coordination ›ong the Military Services to ensure ›t intermodal aspects are fully con›lered.

DOD Directives

Since the submission of the Mili›y Services' study to the Office of › Secretary of Defense, two new ›D directives have been issued. One OD Directive 5160.60] updates an ›lier directive and deals with high›ys to meet the needs of national ›ense. It sets forth policies and re›nsibilities, and assigns authority, in ›tters pertaining to highway needs ›ing peacetime and emergencies in › United States, its territories and ›sessions. It implements the trans›tation engineering definition re›red to earlier with respect to ›lic highways.

›he second directive [DOD Direc› 3224.1] provides for a relatively › program called "Engineering for ›nsportability." Robinson Crusoe, you will recall, ran into trouble ›ause he had not thought about ›ansportability." The raft he took ›h pains to build could not be moved the beach. History is replete with ›mples of similar experiences. It ›pens all the time. The perennial ›dicament of "building a boat in a ›ement" is always with us. This ›nd directive, therefore, sets forth ›icy guidance and assigns responsi›ties for assuring that items of ma›el and equipment are so designed, ›ineered and constructed that the ›uired quantities can be efficiently ›ed by all modes of transportation.

major significance, it directs, ›ong other things, the accomplish›t of three tasks requiring intra›vice coordination:

Issuing, under the sponsorship of appropriate Military Department, joint transportability criteria covering all modes of transportation and terminals, as well as the pertinent characteristics of transportation equipment.

• Ensuring that the transportability of new materiel is determined by field testing during the research, development, test and evaluation programs.

• Issuing, under the sponsorship of the appropriate Military Department, joint transportability guidance for military materiel.

The requirement for defining transportability criteria presents a most difficult problem. As you know, it is not too difficult to test something when test criteria and test procedures have been established. Also, it is not too difficult to provide transportability guidance for the [soldier] on such things as loading, blocking, bracing, lifting and sectionalization when the item is designed to meet transportability criteria and has been field tested. But, those of you who build our transportation facilities, those of you who build transportation equipment, and those of us who are responsible for providing a transportation service have not established criteria that defines and describes the transportation environment things must live in while being transported. Nor has anyone established measurable standards by which these environments can be reproduced for testing.

Unquestionably, it would be helpful if, by a joint effort of the interested technical societies, there were developed some disciplines, some guidelines, and some objectives. I recognize that this is a two-way street and that all of us must contribute to setting specifications for the requirement.

How can we expect the hardware research and development people to do a good job with respect to transportation of the end item if we do not tell them what the environments are, and if we do not furnish them test procedures so they can ensure the hardware is transportable? Also, how can anyone economically design packaging and restraining devices until we have defined the nature and magnitude of forces that will be transmitted to the package and the item?

Problems in Setting Standards

We might ask ourselves, "Why haven't standards or criteria been established?" I do not believe anyone can answer this question fully, but I believe there are at least two contributing causes:

• It is an extremely complex and difficult subject. As a result, a non-engineering operational experience approach has been used. That is to say, the total environment has not been broken down into parts that can be resolved by engineering analysis.

• Uninformed people are afraid of standards because they think they will be restrictive. I am fully convinced that the opposite is the case. I have never known a situation where additional knowledge developed by dependable, thorough, and intellectually honest people hampered or restricted progress. On the contrary, knowledge is the only basis on which we can grow and provide a better transportation service for the manufacturer, the shipper, the user, and the public.

In order that there be no misunderstanding, let me repeat what I said earlier. A lot is known about the transportation environment, but it is known in little bits and pieces, known to many individuals. It has not been brought together and set forth as standards or criteria for guidance to those who must use the transportation systems. Let me also make it clear I fully realize that if it was easy, it would have been done a long time ago.

The recent efforts of the Department of Transportation, with the assistance of the National Research Council's Highway Research Board and the Committee on Hazardous Materials, to learn what is available and what needs to be done to improve the transportation of hazardous materials is commendable. Although this is only one area among many that need to be explored from the standpoint of the item being shipped, the transportation engineering information on environments has application to all commodities, and the possibilities for improvement are great.

In order to present some thoughts worthy of your time and interest here today, I have discussed some of the things the users and purchasers of transportation need so everyone can do a better job. As purchasers of transportation, we at MTMTS are aggressively working at transportation engineering day-by-day and are providing related land transportation services to the entire Defense Depart-

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Organizations registered for service may obtain microfiche copies of these documents without charge from:
Defense Documentation Center
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Keeping Pace with Change

Lieutenant General John S. Hardy, USAF

In today's fast-changing world, the managers of our resources for national security must think clearly and dispassionately, examine alternatives and make decisions from broad points of view based on knowledge in a wide range of fields. The Industrial College of the Armed Forces (ICAF), located at Fort McNair, Washington, D.C. 20315, has been turning out just such leaders through educational programs that are designed to meet the increasing demands of change and of rapid technological growth.

As the pace of change has quickened, our curriculum planners have looked more and more to the future in refining all three of the college's educational programs—the resident course, the National Security Seminars, and the world-wide correspondence program. It is my purpose here to focus attention on the present status of the correspondence program and on some of the new directions in which it is heading.

On Feb. 25, 1969, the Industrial College celebrated its 45th anniversary. War Department General Orders No. 7, dated Feb. 25, 1924, had established the Army Industrial College, under the direction and control of the Assistant Secretary of War, "for the purpose of training Army officers in the useful knowledge pertaining to the supervision of procurement of all military supplies in time of war and to the assurance of adequate provision for the mobilization of materiel and industrial organizations essential to war-time needs."

Almost from the first, the college drew students and faculty from the Navy and Marine Corps, as well as the Army. In April 1946 it was renamed the Industrial College of the Armed Forces, in recognition of its inter-Service character. In September 1948 it was formally reconstituted as a joint educational institution operating under the direction of the Joint Chiefs of Staff.

The mission given to the college 45 years ago has been broadened and developed until today the college stands as the capstone of the military educational system in the management of resources for national security. Its present charter specifically directs the college:

> **To conduct courses of study in the economic and industrial aspects of national security and in the management of resources under all conditions, giving due consideration to the interrelated military, political and social factors affecting national security, and in the context of both national and world affairs, in order to enhance the preparation of selected military officers and key civilian personnel for important command, staff and policy-making positions in the national and international security structure.**

The scope of the charter reflects the changes that have been taking place since World War II in the form and nature of the nation's military institutions, and in most aspects of its national security. Leaders in this field must have some grasp of developments on all fronts, and thorough understanding of developments on many fronts. These developments include: the ever-changing technology of weapons and their impact on tactics, strategy, and logistic support; innovations in organizations and techniques for control and management; the increased influence of international organizations and staff structures; developments in emerging nations; even the involvement of the defense establishment in the domestic scene. These developments have vastly extended the range of interest of the military professional and have placed increasingly challenging demands on our educational programs.

The ICAF Schools

At the heart of the activities of the college is the 10-month resident course, offered each year to 180 selected military officers and government civilian executives. The Resident School uses the term "management of resources" broadly. The school emphasizes the knowledge and skills required for effective decision making at the highest levels of the national security structure. An atmosphere of intellectual freedom and open discussion is encouraged.

The course is action-oriented. It blends formal lectures and small group activities, and encourages individual development through independent reading, study, and writing in areas of particular interest to the student.

The resident course has grown and changed in response to the evolving and increasingly complex pattern of national security. The program now consists of six basic "core" courses which provide a survey of the major facets of national security and resource management. Three semester-length "foundation" courses covering the fields of economics, quantitative analysis, and organization and management support the core curriculum. In addition, electives are offered in various areas related to students'

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career objectives. Optional courses may be taken. Rounding out the resident program are: industrial and international field trips; student research projects; simulation exercises; case studies of historical, problem-solving, and decision-making varieties; panel and group discussions and committee analysis; and a lecture program that features nationally prominent authorities.

Until 1947 the ICAF educational program was confined to the resident course. It became evident, however, that extension programs would be needed in order to reach the many thousands of high-level officers and civilian officials who could not attend in residence. In January 1948, in New Orleans, ICAF introduced a program of 2-week seminars for reserve officers. Within a few years, in response to local initiative, the program was made available to representatives of local business, academic, and civic groups. The Seminar School presents these seminars in selected communities under local sponsorship. Led by officers from the military components of the college faculty, the seminars give the conferees a better appreciation of the basic developments and problems in the management of our national security affairs.

An increasing demand for further extensions of the college program resulted in establishment in 1950 of a graduate-level correspondence course. This course has evolved as an off-post version of the resident course, and has undergone much the same broadening of scope and changes in emphasis over the years. The August 1966 issue of the *Defense Industry Bulletin* carried an article by Major General William S. Steele, former Deputy Commandant of the Industrial College of the Armed Forces, entitled "The New Look of Our Correspondence School." In this article, General Steele pointed out that the school had just started a major adjustment of its curriculum to reflect the new directions and emphasis of the resident course. The changeover has now been substantially accomplished, and many new developments have taken place or are in the offing.

Correspondence Study Programs

Until mid-1967, the Correspondence School offered one course of study entitled "National Security Management." In July 1967, the school embarked on a second, shorter course, "Management in the Department of Defense," which is extracted from the basic National Security Management course. At the same time, the school introduced a Selective Study Program, in which individual texts and monographs from the National Security Management course may be used for information in a specific subject area. Through the two formal courses and the Selective Study Program, the school affords greater flexibility to prospective students in their studies of areas most appropriate to their needs or interest.

National Security Management.

National Security Management is the Correspondence School's basic course of instruction. It contains study material covering the fundamental aspects of areas of knowledge that are essential to effective management of national security. National Security Management is adapted from the subject matter of the resident curriculum to the correspondence method of study. The subject matter is selected and organized to provide a basic understanding of a wide area and to avoid minor details and useless generalities. It is not designed to train specialists in any particular field but, rather, as the ICAF charter directs, to impart knowledge and understanding of the economic and industrial aspects of national security, and of the management of resources in all conditions and in the context of both national and world affairs.

The course material is presented in small bound volumes, and is organized into five integrated units of study:

- **Unit I, Foundations.** This unit presents a look at the role of the United States in concert with other nations, in the world community, and the top-level direction and management of our national security affairs. In addition, it provides an orientation in the elements of basic economics and of economic analysis, and in the concepts and practices of modern management.
- **Unit II, The Resources Base for National Security.** This unit appraises our available resources for achieving security. These economic capabilities and significant potentials include human, natural, and energy resources; science and technology; transportation; and three important utilities (electric power, natural gas, and telecommunications). A final volume in this unit, The Industrial Sector, reviews the evolution, major characteristics; structure, magnitude, and growth trends of the American industrial economy; and the role of production with its interlocking relationship to other elements of the economy, and its importance to the nation's strength and well-being.
- **Unit III, Plans and Programs for National Readiness.** This unit presents information relating to certain basic national policies which provide the framework within which national security is managed. Subjects include programs and policies to maintain the strength, stability, and dynamism of the national economy as the essential base for the nation's security; U.S. foreign economic policy; U.S. collective defense and foreign assistance programs; the methods and current planning for economic stabilization under various conditions of emergency; and the nature and scope of the problems anticipated in the event of a nuclear attack on the homefront and the preparedness measures that are being taken to deal with these problems.
- **Unit IV, Defense Plans, Policies, and Decisionmaking.** This unit introduces the student to the concepts, principles, and policies which underlie and give direction to the managerial effort in the Defense Department. Areas receiving primary attention include Defense organization, planning, programming, budgeting, and systems analysis.
- **Unit V, The Management of Defense Programs.** This unit deals with management in specific functional areas within the Defense Department: research and development, procurement, production, and supply management.

To help keep pace with ever-changing concepts and new developments, particularly in DOD's broad areas of interest, the 24 textbooks that now comprise the National Security Management course are supplemented by a series of monographs, chapter-length surveys dealing with specific national security and defense management problems. All break new ground. The substance of some monographs will find their place in the periodic revision and updating of existing texts; other monographs will form the basis for new, full texts in select defense management areas.

Since the beginning of the mono-

graph program in 1967, the following monographs have been published:

- Defense Resource Management Systems: Project PRIME
- Production Management: The Defense Materials Systems
- International Logistics: Interallied Collaboration in Weapons Production
- International Logistics: Foreign Military Sales
- Defense Manpower: The Management of Military Conscription
- Defense Manpower: Management of the Reserve Components
- Defense Transportation: The Military Traffic Management and Terminal Service
- Maintenance Management in the Department of Defense
- Management of Defense Intelligence
- Defense Weapon Systems Management
- Defense Planning and Budgeting: The Issue of Centralized Control

At present, monographs are being developed on resource management in conditions of limited war, integrated logistic support, systems analysis and the political process, and the role of DOD in civil disturbances. The monograph series is important as a means of dealing with the problem of textbook obsolescence and of adding to the freshness and vigor of the instructional programs.

Correspondence School students as well as graduates now receive the ICAF journal, *Perspectives in Defense Management*. Each issue of *Perspectives* contains a representative selection of current Resident School auditorium presentations, student research reports, and other materials drawn from the educational programs of the college. From time to time, as the situation warrants, students receive additional materials, such as the abridgments of the posture statements of the Secretary of Defense which appeared in recent issues of the *Defense Industry Bulletin*.

Management in the Department of Defense.

This course is based on 11 text books from the comprehensive National Security Management study program, supplemented by monographs focusing on defense management. There are two integrated units of study:

- **Unit I, The Environment of Defense Management**, contains two elements. The first, Orientation: The Underlying Disciplines, presents the broad managerial and economic concepts which form the interdisciplinary approach to management in DOD. The second element, Defense Plans, Policies, and Decisionmaking, introduces the student to the concepts, principles, and policies that underlie and give direction to the managerial effort in DOD. Areas given primary attention include: defense organization, planning, programming, budgeting, and systems analysis.
- Unit II, The Management of Defense Programs, deals with management in specific and related functional areas within the Defense Department's missions: research and development, procurement, production, and supply management.

As in the case of the National Security Management course, supplementary monographs and other materials introduce the student to additional functional areas of defense management and to new and particularly significant developments in this field.

Selective Study Program.

The Selective Study Program is available to a limited group of officers and civilian officials who have need for information within specialized areas. This is not a formal course of study. Individual textbooks and monographs are selected from the basic National Security Management course.

The Bluebooks

The success of the three study programs depends in large measure on the quality and timeliness of the Correspondence School's educational materials. In this respect, the school's specifically tailored textbooks—popularly referred to as "bluebooks"—have been of paramount importance. Plans for curriculum development are prepared, reviewed and revised each year on the basis of a 3-year textbook development and revision cycle. The objective is to achieve the maximum practicable correlation with resident instruction and to reflect the ever-changing perspectives, concepts, and problems in defense and national security management.

A small textbook development group within the Correspondence School devotes much of its time and effort to this task. In collaboration with other members of the Industrial College faculty and with the assistance of outside experts and selected resident students, the group has been through two full cycles of textbook development and revision since its activation early in 1961. Drafts of new and revised textbooks and monographs are coordinated with the college's Academic Plans and Research Office and the Resident and Seminar Schools. These and other components of the college have helped the Correspondence School to ensure that its instructional materials are sufficiently comprehensive to achieve educational objectives; are accurate and reflect current knowledge and practice; are prepared by professionally qualified personnel; are organized and presented in accordance with sound psychological principles of learning; and are attractive in layout and format.

The following textbooks are now in use:

- The Environment of National Security
- The National Security Structure
- Elements of Defense Economics
- Management: Concepts and Practice
- Human Resources for National Strength
- Natural and Energy Resources
- Transportation: The Nation's Lifelines
- Utilities: Electric Power, Natural Gas, and Telecommunications
- Science and Technology: Vital National Assets
- The Industrial Sector
- Economic Policies for National Strength: The Quest for Sustained Growth and Stability
- United States Foreign Economic Policy
- Emergency Economic Stabilization
- Civil Defense: Planning for Survival and Recovery
- Collective Defense and Foreign Assistance
- Defense Organization and Management
- A Modern Design for Defense Decision: A McNamara-Hitch-Enthoven Anthology
- Case Studies in Military Systems Analysis
- A Commentary on Defense Management
- Requirements: Matching Needs with Resources
- Defense Research and Development
- Procurement
- Production for Defense
- Supply Management

Of these 24 texts, only 3 bear publication dates going back to 1964. Two were published in 1965, 5 in 1966, 6 in 1967, and 8 in 1968. Work is in process to update the few oldest texts. All in all, considering the long lead times from conception to production and publication of textbooks, the Industrial College can take rightful pride in the currency, as well as in the high quality, of its bluebooks.

Although they are designed basically for its instructional needs, the Correspondence School's textbooks are used extensively in other ICAF programs and in the programs of other government agencies. All Services, for example, draw heavily on the bluebooks in support of their ROTC programs. The Business and Defense Services Administration of the Com-

merce Department recently ordered 3,000 copies of the ICAF text, "Production for Defense," for use by agency headquarters and field staffs, and for the orientation and training of BDSA's National Defense Executive Reservists.

Forward Planning

Along with other components of the Industrial College, the Correspondence School has been projecting its plans and programs on a 5-year basis, which helps to ensure an orderly identification of education requirements and permits suitable planning for the best use of resources. The school is guided by college-wide assumptions about the future world, domestic and defense environments, the clientele to be served, and basic educational goals. Within this frame of reference, the school plans its operations so as to improve on-going programs and to meet projected educational objectives over a reasonable period.

To date, much of the Correspondence School's effort has been directed to the conduct and support of individual home study under the National Security Management and Management in the Department of Defense courses. In the past year the school began to expand a concept in educational methodology—one that combines the advantages of guided self-study with those of group discussion. This group study program places emphasis on individual preparation and study as a prelude to group discussion. At the group meetings each member presents his opinions and reactions, and compares his experience and thinking with those of other members. This provides a strong motivation to the individual participants and helps to develop and project intellectual and leadership capabilities. Enrollments in group study now total approximately 4,000 (2,000 Army, 500 Navy and Marine Corps, and 1,500 Air Force).

Group study programs have been organized for the most part in local reserve officer training schools and units. The Military Services provide facilities and instructors; ICAF enrolls each student individually, provides text materials, tests, evaluating and counseling services, and assists in the development of instructors' guides.

In addition, a number of study groups, containing a mixture of reservists, regular officers, and civilians, have been organized, mainly in the Washington area. On occasion, ICAF faculty have served as visiting instructors for these local groups. We contemplate expanding this program, with increasing ICAF participation and, if experience indicates the desirability of such action, with ICAF leadership of some groups.

Looking further into the future, ICAF may conduct or sponsor an Associate Correspondence Course, using the group-study approach and aimed primarily at active duty military and government civilian officials at major headquarters and bases of military and other government departments, to whom reserve officer group-study is inaccessible or inconvenient. If considered to be desirable and practicable, this program will be extended progressively, with ICAF playing a large role in providing study materials, guidance, instruction, monitoring, and inspection.

Still further in the future is the concept of a Senior Associate Correspondence Course. Conducted by ICAF, that course would be aimed primarily at senior active-duty and reserve officers and government executives in the Washington, D.C. area, who are not able to attend the resident course. Based on the National Security Management and Management in the Department of Defense course materials, this course would be supplemented extensively by study materials drawn from the resident program. It may include limited attendance at Resident School lectures, and could well develop ultimately into an "associate" resident program.

Also in the concept stage is an advanced course on defense decision making. This is visualized as a home-study program for graduates of the resident or correspondence courses. Rigorous educational qualifications for admission would be established, and the course would be based on specially developed materials focused on sophisticated aspects of defense decision making. The course requirements would be demanding, and students would have wide latitude for individual specialization.

The move toward group study has created a need for comprehensive guidance for instructors in the effective conduct of discussions. The Correspondence School is cooperating with the Military Services in the design of instructors' guides for use in reserve officer group study programs. ICAF may ultimately assume full responsibility for the design of instruction guides for all existing, new, and revised texts, as well as for the preparation of course outlines, summaries, interpretative commentaries, and other materials. These would help individual students, as well as group leaders, to get the greatest benefits from Correspondence School programs.

The Correspondence School will strive for continuing improvement of curriculum materials, educational methodology, and evaluation techniques in both its home and group-study programs. It is continually developing and systematically refining course materials, and is making meaningful estimates of student comprehension and achievement. Multiple choice examinations have been constructed to measure learning effectiveness in terms of clearly defined educational objectives. The school follows a constructive program to encourage students to start, continue and finish the courses in which they have been enrolled, and professional counseling reinforces learning.

Considerable effort is now going into design, testing and validation of test items, analysis of results, and standardization of examinations.

An Opportunity for Self-Development

Considering the importance of the issues involved in our national security and the proportion of resources devoted to its support, education of present and future policymakers and leaders in this field cannot be passed over lightly. For those who cannot attend the resident course, the Correspondence School's programs offer extraordinary opportunities to develop the professional attitudes, perspectives, and breadth of view needed for leadership in today's defense environment. The school's objective is *education, not training*. Specialists, as well as generalists, will profit immeasurably from close, disciplined study of the texts and other educational materials used in the Correspondence School's two formal courses of instruction. Successful completion of these courses requires diligent application of time and effort: an average of 12–15 months for the National Security Management course; and some 4–6 months for the shorter, derivative

Management in the Department of Defense course.

Enrollment in ICAF Correspondence School programs requires a college education through the baccalaureate level or its equivalent in professional experience. Specifically, the National Security Management and Management in the Department of Defense courses are open to:

Military officers of all components of the Defense Department and the Coast Guard who are serving on active duty.

Military officers of all components of the Defense Department and the Coast Guard who are on inactive duty in the grade of major or lieutenant commander and above. Also, officers of junior grades who are affiliated with an organized reserve program or reserve officers' school may be enrolled.

Federal, state, or local government employees rated GS-11 (or equivalent) and above will be accepted, and trainees in civil service intern programs with lower ratings may be accepted if they are recommended by appropriate supervisors.

Civilian executives and members of the several professions may be accepted if ICAF resources permit.

All applicants are considered on their individual merits. In some instances, applicants who do not fully satisfy the specified selection criteria may be accepted on a conditional basis, and participation on this basis will be continued as long as the student demonstrates satisfactory progress.

The selective study program is open to military officers of all components of DOD serving on active duty in the grade of lieutenant colonel or commander, and above, and to Federal employees rated GS-13 and above.

Course materials are provided at no cost to the student. Each student who successfully completes a study program is permitted to retain the texts and the supporting monographs and related materials for his personal library. In most instances, the texts will remain on the graduate's bookshelf within easy reach for re-reading and reference.

A certificate of completion signed by the Commandant of the college is issued to everyone who satisfactorily completes either the National Security Management program or Management in the Department of Defense program. Distinguished graduates in either course receive special letters of recognition. Satisfactory completion of the courses by military officers and civilian government employees is officially reported to the appropriate Military Service or civilian agency.

Reserve officers not on extended active duty may earn 60 reserve points through successful participation in the National Security Management study program. These officers may earn 24 reserve points through successful participation in the Management in the Department of Defense program. Reserve points have not been authorized for the selective study program.

Over and above the special incentives of reserve points, certificates of completion, and the opportunity to acquire a unique collection of books, there is the satisfaction of having undergone a rich educational experience. The Correspondence School's programs go far to broaden the student's horizons and sharpen his professionalism. The graduate's reward will lie in the knowledge that, through this extra effort, he is better equipped for service in the national and international security structure. In this respect the ICAF Correspondence School is not just one more instrument for continuing education; it is a vital component of the nation's preparedness for leadership in emergencies.

U.S. Army Test and Evaluation Command

(Continued from Page 6)

oping, producing, supplying and maintaining the Army materiel scheduled to be in the pipeline at that time.

TECOM is plugged into the main logistics circuit. It is part and parcel of the total system. At the very least, the command's test reports and recommendations provide the reliable basic data needed for evaluating Army materiel at any stage in its life cycle—from concept to discard.

Already rich in experience, the seven-year-old Test and Evaluation Command represents the Army's first long step in the direction of an ideal test organization. Its further development as the principal decision-making tool in the Army's new logistics system is limited only by its capability to absorb and exploit tomorrow's technology, management processes, methodology, instrumentation and engineering concepts.

In short, when our legions are sent to the stars, TECOM will be ready. It has already tested vehicles for use on the surface of the moon!

Electronics Aid Photomapping for Air Force

A new electronic aid to airborne geodetic surveying, the Refractive Index Sounding System (RISS), is being developed for the Air Force.

The system is being produced by the Bendix Environmental Sciences Division, Towson, Md., under the direction of Aerospace Instrumentation Program Office of the Air Force Systems Command's Electronic Systems Division, L.G. Hanscom Field, Mass.

RISS will be used to gather meteorological data, such as temperature, pressure and humidity, for computation of the atmospheric refractive index. This, in turn, will permit correction of radio signal tracking errors caused by water vapor in the atmosphere. The corrections result in increased accuracy of longitude and latitude determination on photographic maps.

The RISS program calls for 10 portable sounding systems, to be completed in 1970. Each unit includes an antenna, baseline calibration chamber, gasoline generator and balloon radiosonde.

Eventually, RISS will be used in the Aerospace Cartographic and Geodetic Service's photomapping mission to conduct world-wide photomapping surveys.

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ASPR Committee Case Listing

The following is a listing (revised as of June 9, 1969) of the cases currently under consideration by the Armed Services Procurement Regulation (ASPR) Committee, of the Office of the Assistant Secretary of Defense (Installations and Logistics).

On items marked by asterisks, the text has been omitted to shorten the listing. The asterisks denote actions taken as shown below:

**—Case closed, no ASPR revisions resulting.*

***—Case closed, approved for printing in a subsequent ASPR revision.*

****—Case closed, approved for printing subject to further government coordination.*

The listing includes subjects of interest to contractors but excludes cases of a minor or editorial nature, those considered sensitive, and those involving a deviation from the regulation which are processed by the ASPR Committee.

The ASPR Committee meets with representatives of major industry associations periodically to explain the purpose and status of each of the cases under consideration, and to answer questions from industry representatives concerning the cases. All proposed ASPR changes of major policy are forwarded to industry associations in draft form for the review and comments of the association memberships. Industry comments are evaluated by the Defense Department before a final decision on the proposal is made by the ASPR Committee.

***Rental Charges for Use of Government Property.**

****Cost Principle—Depreciation.**

****Equal Employment Opportunity.**

Review of the Implementation of Public Law 87-653. To undertake a review of the ASPR implementation of Public Law 87-653 on the basis of the experience thus far obtained, to determine the need for further guidance or clarification of such coverage. This review has been divided into five broad areas as follows:

(a) The submission of data. When is data submitted? Submission vs. disclosure or availability. Identification of data. Contracting officer (and other) documentation.

(b) Definitions of "current" and "complete." From the standpoint of reasonableness and practicability. How should significance be considered?

(c) Examination of Records. Audit before negotiation Audit after contract award. Audit of subcontractor data.

(d) Subcontract Problems. Subcontracts under firm fixed-price primes. Second- and third-tier subcontracts.

(e) Significance. From the standpoint of price negotiation vs. application of defective pricing clause. Price changes after price agreement but before contract award.

Proposed coverage on (a), (b), (c) and (e) was previously circulated to industry for comment, and the results of this effort were issued in Defense Procurement Circular No. 57, dated Nov. 30, 1967.

Proposed coverage on the subcontract aspect of this matter has been forwarded to industry and other government agencies for comment. The comments have been received and consideration of this aspect of the problem is continuing.

Cost Information Reports (CIR). Proposed ASPR coverage for Cost Information Reports has been developed and was approved for print by the ASPR Committee. However, printing has been withheld because the basic DOD instruction is being revised and the changes contemplated will require redrafting the ASPR coverage. A CIR clause was issued in ASPR Revision No. 30, dated Sept. 1, 1968. Revision of the instruction is still in process.

*****Contract Modifications.**

***Handbook for Procurement Quality Assurance.**

Communications Services. Development of uniform ASPR coverage which would permit deletion of existing departmental coverage with respect to procurement of communication services from both regulated and unregulated suppliers. Industry comments have been received, considered and revised coverage developed. Final action on this coverage has been delayed awaiting review by higher authority.

Advance Understandings of Allowability, ASPR 15-107. To revise the existing ASPR paragraph to explicitly provide that such agreements must be in writing to be binding on the Government. Proposed ASPR coverage concerning Advance Understandings on Particular Cost Items was forwarded to industry for comment on May 29, 1968. The subject matter, together with comments received from industry and other government agencies, are still under consideration.

***Compensation Review Procedures.**

****Help Wanted Advertising—ASPR 15-205.33.**

Technical Data Warranty. To consider the advisability of incorporating in ASPR a warranty clause for technical data. Proposed ASPR coverage with respect to the subject matter was forwarded to industry for comment on May 17, 1968. Industry comments have been received and considered, and the proposed ASPR coverage developed under the subject matter has been approved for printing subject to ratification by higher authority.

****Predetermination of Rights in Data.**

***Reporting of Labor Disputes.**

***Modification of Weighted Guidelines To Give Greater Recognition to Invested Capital.**

****Purchase vs. Lease; Allowability of Costs under ASPR 15-205.34 and 15-205.48 for ADPE, Other Equipment and Buildings.**

Revisions to ASPR 15-205, Cost Principles on Bid and Proposal and Independent Research and Development. The proposed revisions to the existing ASPR cost principles on Independent Research and Development and Bid and Proposals were developed as a staff action outside of the ASPR Committee, and referred to the committee for editing and obtaining of industry comments. This material was forwarded to industry on Jan. 29, 1968. On March 25, 1968, the reporting date for submission of comments by industry and government agencies was extended to June 30, 1968. Industry comments have been received and are under study.

****Revision to ASPR 15-205.41—Taxes.**

****Evaluation of Options.**

****Limited Rights Legend.**

Clauses for Service Contracts. To develop a new part for ASPR Section VII to cover service contracts generally, incorporating by reference to the extent feasible the fixed-price and cost-reimbursement clauses contained in Parts 1 and 2 of Section VII. This matter is still under development.

****Organization Costs, ASPR 15-205.23.**

First Article Approval. To consider revising the First Article Approval policy set forth in Section I, Part 19, in light of the difficulties which have been experienced both by the Government and by industry under the existing ASPR coverage. Consideration of a proposed revision of the subject matter began in June.

Revision of the CWAS Coverage. To consider recommendations submitted by the Industry Advisory Council Working Group to lower the threshold and also extend the CWAS coverage to certain areas of administrative controls now excluded from the CWAS coverage. Consideration of this matter began in June.

Proposed ASPR 9-203(f) Clause, Rights in Technical Data—For RDT&E and Acquisition Contracts for Major Systems and Subsystems. To consider modifying the ASPR policy, concerning rights in technical data, insofar as RDT&E and Acquisition Contracts for Major Systems and Subsystems are concerned, by prescribing a special cause for inclusion in prime major systems and prime subsystems RDT&E contracts which would require the contractor to permit subcontractors to sell subcontractor fabricated parts or services directly to the Government without the payment of license fees or other inhibition notwithstanding that such subcontractor effort may require the use of limited rights data furnished by the prime contractor. Consideration of the coverage in this area was delayed awaiting receipt of comments from CODSIA. The comments, dated April 28, 1969, are now under study.

Mandatory Application of ASPR Cost Prin-

iples in Fixed-Price Contracts. To develop a evision of ASPR Section XV to make use of he cost principles set forth in Parts 2, 3 and mandatory in fixed-price contracts, whenever osts are relevant in the pricing of fixed-price ontracts. A draft of the proposed coverage to ccomplish the foregoing was forwarded to industry for comment on May 14, 1969

**Aircraft, Missile, Space Vehicle Accident Reporting and Investigation Clause.

Title and Risk of Loss Clause—7-103.6, Applicability to Cost Reimbursement Type Contracts. To consider the applicability of the Title and Risk of Loss Clause, ASPR 7-103.6, to cost-reimbursement type contracts, in light of a letter from AIA, dated April 9, 1969. This problem is under consideration by the committee.

Definitization Clause for Letter Contracts. Industry comments on the proposed clause have been received This matter is currently under consideration.

*Contributions and Donations.

ASPR 14-406, Nonconforming Supplies and Services. Revise ASPR 14-406 covering Acceptance of "Nonconforming Supplies or Services" to emphasize government policy that supplies or services which do not conform in all respects to the contract requirements be rejected; and to simplify the administrative burden created by the acceptance of nonconforming supplies and services. This matter was forwarded to industry for comment on May 1, 1969.

Amendment of Certain ASPR Provisions Relating to Patents and Data. To update and correct ASPR Section IX dealing directly or indirectly with respect to Patents and Technical Data provisions without making any substantive change in the section, as well as providing a new assignment form for use in lieu of the form presently appearing is ASPR 9-109.4. This material was forwarded to industry for comment on April 10, 1969.

Delinquent Delivery Schedules on Other Than Cost-Reimbursement Type Supply and Service Contracts. To modify various provisions of Section VIII, Part 6, to clarify the rights and obligations of both parties in the event of delinquent performance. The proposed revisions were forwarded to industry for comment on March 3, 1969.

Review of Bid Protest Regulations. To consider the recommendations of the Senate Select Small Business Subcommittee with respect to the subject matter in coordination with the General Services Administration (GSA). Changes to the ASPR and FPR coverage in the subject area have been developed and are currently being considered by higher authority in DOD and GSA. Upon ratification, these changes will be issued in subsequent revisions to the two regulations. It is not contemplated that industry comments will be solicited in this area.

Proposed Revision to ASPR 15-203 Regarding Off-Site Burden Rates. To revise 15-203(d) to emphasize the possible requirement for special overhead rates for contracts performed at locations physically removed from the contractor's primary location. The proposed revision in this area was forwarded to industry for comment on March 3, 1969. Comments have been received and are currently under consideration.

Application of Burden to Settlement Expenses and Settlements with Subcontractors. Proposed revisions to ASPR Section XV, 15-205.42(f) and (g) to clarify the treatment of settlement expenses taken into account following termination were forwarded to industry for comment Feb 6, 1969. Industry comments have been received and are currently under consideration.

Accounting and Control for Government-Owned Property. This case, which addresses itself to the responsibility for loss or damage to government property occurring during the period when an acceptable property system was not maintained, has been circulated to industry for comment. These comments are presently being evaluated by a subcommittee before further review by the Contract Administration Panel and the ASPR Committee.

Transfer of Materials Between Contracts. This case addresses itself to a proposal to permit easier transfer of material between contracts, and to permit retention by contractors of excess, contractor-acquired, government-owned material at the lesser of cost or market, and was submitted to industry for comment on Feb. 18, 1969. Comments have been received and are being considered.

CODSIA Termination Recommendations. This case contains requirements for the contracting officer to notify the contractor under a partially funded cost-reimbursement type contract to submit a proposal for the adjustment of fee when the contractor is approaching the limits of the funds allotted to the contract, and the contract is not to be further funded. Other miscellaneous changes in Section VIII are also included. The case was submitted to industry for comment on Feb. 27, 1969. Comments have been received and are being considered.

"Terminations - Deferring Determination Whether for Default or Convenience" Clause. To consider whether an ASPR clause embodying the subject concept should be developed for inclusion in the regulation. Such a clause, halfway between the present ASPR "Default" clause and the present ASPR "Termination for Convenience of the Government" clause, would permit termination of a contract while deferring the contracting office's decision as to whether (1) the contract is in default or (2) termination should be for convenience of the Government. To also consider whether the "Stop Work Order" clause should be modified to authorize conversion of a stop work order to a termination for default as well as a termination for convenience, as is now provided.

Guidelines for Administration of Small Business/Labor Surplus Area Subcontracting Program Clauses. To develop uniform guidelines for administration of the Small Business/Labor Surplus Area Program clauses at both the prime and subcontract level. The ASPR coverage upon adoption would supplant the similar though not identical coverage currently used by the Military Departments.

Foreign Tax Clause, 11-403. To consider whether the Foreign Tax clause, prescribed by 11-403, should be revised in light of the letter received from CODSIA, dated Dec. 20, 1968, recommending adoption of a revised foreign tax clause.

Conflict of Interest Clause. To consider whether further guidance in the regulation and appropriate contractual safeguards should be provided to avoid conflicts of interest which may be occasioned by acquisitions and mergers involving systems engineering contracts.

ASPR Section IX, Part 2. To consider whether amendments to Section IX, Part 2, and other pertinent ASPR sections are necessary in view of the re-issued DOD Instruction 5010.12, dated Dec. 5, 1968, entitled, "Management of Technical Data."

Use of Firm Fixed-Price Contracts for Development. To consider whether the ASPR coverage concerning use of firm fixed-price contracts for development should be revised in the light of studies made by the Military Departments in addition to prior changes made in the ASPR Revision No 30

Construction Warranty Clause, ASPR 1-324.10. To develop a revision of the subject clause in light of comments of the Association of General Contractors covering (1) design, (2) damages from defects and failures, and (3) use of the term "agent."

Specially Rated DOD Insurance Plans; (A) DOD Term Insurance Plan and (B) The National Defense Project Rating Plan. To review the cited insurance plans to ascertain whether revisions thereof are necessary in order for them to accomplish their intended purposes, particularly in the light of the fact that the plans are not being used to the optimum extent.

Recommended Changes to (A) Group Insurance Plans Under Cost-Reimbursement Type Contracts, 10-505, and (B) "Insurance-Liability to Third Persons" Clause, 7-203.22. To consider a revision of (1) 10-505 "Group Insurance Plans Under Cost-Reimbursement Type Contract" to provide for review by insurance personnel of the Military Departments, rather than approval and submission of the insurance representative's findings to the Defense Contract Audit Agency as to the allowability of costs of such plans, and (2) 7-203.22 "Insurance-Third Party Liability" clause to make mandatory the submission of group insurance plans under the clause to the Government for review.

Location Allowances at Unfavorable Locations. To consider whether the desirability of removing the current language in 12-105 and 15-205.6(j) on the basis that the existing coverage is no longer necessary, does not serve a useful purpose and, thus, should be eliminated. In conjunction with this action, to consider the desirability of modifying 15-107(1) to add coverage with respect to allowances for off-site pay, incentive pay, location allowances, hardship pay, cost of living differential, and the like.

Verification of Catalog or Market Price Exceptions Under Public Law 87-653. To consider the recommendation of the General Accounting Office that ASPR be revised (1) to require contractors to submit sales data of recent commercial sales for approximately similar quantities of the proposed purchase by the Government, prior to acceptance by the Government of a catalog or market price; and (2) to further provide that contracting officers be required to verify the sales data submitted by contractors.

Health and Safety Clauses. To review and present recommended changes concerning the applicability of the Health and Safety clauses currently prescribed in 7-104.78, .79 and .80, in light of the comments on this matter received from CODSIA.

Government Property Clauses. To consider the desirability of revising the Government Property clauses to require contractors to assume responsibility for low dollar amount repairs to government furnished property, thus paralleling the procedure currently used in the Ground and Flight Risk clause which eliminates the administrative burden resulting from low dollar value claims under the Ground and Flight Risk clause.

Revision of ASPR B-311, C-311 and S3-603. To make necessary revisions to Appendices B-311 and C-311 and Supplement 3 to provide for uniform reporting by contractors on gov-

(Continued on Page 36)

Air Force Flight Dynamics Laboratory—Focal Point for Most Flight Vehicle System Technology

Colonel Joseph R. Myers, USAF

The Air Force Flight Dynamics Laboratory—Where is it? What is its mission? What is it? What does it do, and what is portended for its future? The Air Force Flight Dynamics Laboratory (AFFDL), located at Wright-Patterson AFB, Ohio, is one of the nine laboratories of the Air Force Systems Command (AFSC). In consonance with its mission, it is the focal point in the Air Force for all technology associated with flight vehicle systems, except for the propulsion and avionics subsystems. The broad flight vehicle technical domains for which the laboratory has responsibility are:

- Structures.
- Flight mechanics (aerodynamics, aerothermodynamics, performance and trajectory analysis).
- Dynamics (vibration, flutter and acoustics).
- Flight control (stability and control, handling qualities, cockpit displays, components and subsystems).
- Vehicle equipment (internal environmental control, retardation and recovery, crew escape and crew stations, airframe bearings and landing gear subsystems).

The program of the laboratory (both in-house and contracted) contains the Air Force exploratory and advanced development effort associated with the forementioned technical domains.

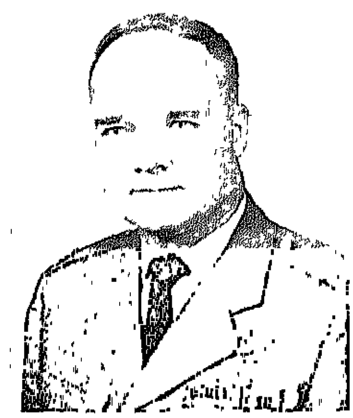
Basic objectives to which the laboratory addresses its effort are, first, to conduct an exploratory and advanced development program which is directed toward the solution of critical technical problems anticipated in the development of future Air Force flight vehicles; second, in the laboratory's areas of responsibility, to continually enlarge and upgrade techniques, design criteria, ground and flight simulation methods and instrumentation which can be used as a technological foundation for the design of advanced flight vehicles, possibly not yet even in the concept stage; and, third, to provide quick response solutions to Air Force problems associated with operational flight vehicles, particularly those involved in Southeast Asia and with flight vehicles under development.

In fulfilling these objectives and responsibilities, the laboratory must conduct unceasing review and assessment of the possible enemy threats and current and future needs, as expressed in research and development guidance sources, to ensure that its program is responsive. This function has a further payoff in that, when industry responds to Requests for Proposal on contracted portions of the laboratory's research and development program, it can do so with the knowledge that these programs reflect future Air Force requirements. This knowledge enables industry to better plan its own internal flight vehicle technology research and development programs, using Air Force guidance toward areas of future interest.

Further coupling with industry is provided through laboratory review of the work being accomplished under independent research and development programs of the major airframe manufacturers. The laboratory is charged by DOD with this responsibility in the areas of flight vehicle technology. Exchanges of viewpoints on needs and the work being conducted and planned are intended to lead toward more significant efforts and findings. The laboratory, also, constantly assesses the effort of flight dynamics research and development being conducted in other Service laboratories, the National Aeronautics and Space Administration (NASA), the Federal Aviation Agency, and industry. This assessment ensures knowledge of the current relevant state of the art and assures more effective direction of efforts, particularly important in view of limited budgets.

A viable interface with the technical and scientific community, and an awareness of military and national goals and changing bases of technology, is maintained through participation by laboratory personnel in a wide range of organizational activities. They serve on planning and working units of inter-Service, national and international groups. AFFDL personnel are assigned to committees and special groups of DOD, the Defense Atomic Support Agency, Headquarters, U.S. Air Force, NASA, NATO's Advisory Group for Aerospace Research and Development, the American Institute of Astronautics and Aeronautics, and American Standards Association, the National Academy of Sciences, and a large number of technical and scientific societies.

In ferreting out Air Force current and future technical needs in the various areas of flight dynamics, AFFDL uses several techniques. To obtain data and define problems in-



Colonel Joseph R. Myers, USAF, is Director of the Air Force Flight Dynamics Laboratory. In prior assignments, he was Commander, 6511th Test Group (Parachute), and Test Force Director, X-20 Dyna Soar. Colonel Myers is a graduate of Purdue University and holds a masters degree in aeronautical engineering from the Massachusetts Institute of Technology.

volving capabilities of flight vehicles in the Southeast Asia conflict, teams of specialists have been sent to the area for on-the-spot determinations. For example, a comprehensive aircraft survivability program for conventional weapon threats was developed from such initial surveys. A common method for determining needs has been working level, eyeball-to-eyeball discussions with personnel from the Air Force's operational commands and AFSC's product divisions (Aeronautical Systems Division, Electronic Systems Division, and the Space and Missile Systems Organization). To ensure that the laboratory program is properly responsive, AFFDL personnel review documented technical needs from the product divisions for program guidance.

Diversity of Technical Effort

Some of the technical concepts which the laboratory has recently explored and advanced in response to Air Force needs are:

- Self-contained aircraft oxygen systems.
- Steerable parachutes.
- Beryllium structural members.
- Development of XV-4B aircraft for VTOL flight control research.
- Expandable aircraft tires.
- Air cushion landing gear.
- Portable low visibility approach and landing equipment.
- Survivable flight control system (fly-by-wire).
- Dynamic vehicle loads determination for substandard landing sites.
- High lift-to-drag reentry vehicle configurations.
- Improved vehicle trajectory analysis techniques.
- High temperature structure incorporating cryogenic tankage.

A few of these will be described briefly to indicate the scope and status of the efforts. Some of the concepts have been developed to the point of incorporation into flight vehicles. AFFDL efforts are bringing many of them into consideration in the design and development cycle of a number of vehicles.

A new on-board oxygen supply system, which concentrates oxygen from the air, is in final development for use in fighter aircraft. Feasibility has been established for this unique device in which a highly reliable static electrolytic cell produces 100-percent pure breathing oxygen. Successful development of the oxygen concentrator will revolutionize breathing oxygen logistics by eliminating the need for the present extensive ground support facilities and equipment associated with liquid oxygen manufacture, storage, transportation and servicing.

The laboratory has developed prototype automatic homing parachute systems for precise delivery of urgently needed supplies and equipment. A steerable radio-homing system has been flight demonstrated to the Tactical Air Command. Inherent in this concept is the almost limitless size of the parachute payload, which may be small emergency supply packages or heavy earthmoving equipment, trucks, artillery, nose cones, or satellites. The steerable parachute is potentially important for applications ranging from situations such as the Vietnam war to space program endeavors.

Initial use of beryllium as a primary load-carrying aircraft member was a joint effort of AFFDL and McDonnell-Douglas Corp. to design, build and flight test a beryllium rudder on an F-4 aircraft. This rudder is 35 percent lighter than the production F-4 rudder and four times as stiff. While the use of beryllium in the F-4 rudder is not a "cost effective" application, this program has demonstrated that beryllium design technology for aircraft use is "here." As a result, beryllium can be considered in future systems where its outstanding strength/weight ratio can justify its cost.

AFFDL has complete technical and management responsibility for developing flight control system criteria and techniques for vertical takeoff and landing (VTOL) aircraft. The VTOL program, the only one of its type underway in this country, involves the design, development and test of the XV-4B jet-lift vehicle. A variable stability capability will be installed as an integral part of its control system. This installation will permit duplication of the dynamics of other VTOL vehicles, thus providing a unique research and development test capability.

The laboratory is moving into the second phase of development of air-cushion landing gear (ACLG) for aircraft. This involves deletion of the complete normal landing gear subsystem from the aircraft, including struts, retracting mechanisms, wheels, brakes and axles. The ACLG concept is based on the ground effect principle, employing a stratum of air instead of wheels as the aircraft ground contacting medium. A large rubber tube, over three feet in cross-sectional diameter when inflated, encircles the bottom of the aircraft fuselage and provides an air duct and seal for the air cushion. The tube is deflated in flight in a manner similar to de-icing boots on the leading edge of wings. The bottom of the tube contains a large number of nozzles through which the air passes into the air cushion cavity. Due to low ground overpressure (1 to 2 psi), this concept enables an aircraft to operate from surfaces now limited to swamp buggies. It is also highly resistant to small arms fire.

The same principle is used on air cushion vehicles (ACVs) which have already demonstrated their versatility, both as commercial ferries and as very useful military vehicles in South Vietnam. As an AFFDL-funded program in conjunction with Bell Aerospace Corp., the ACLG concept has experienced an evolutionary process from wind tunnel and dynamic free fall models to an actual flight test vehicle, the Lake LA-4. Floating on a cushion of air only a fraction of an inch above the ground, the LA-4 has demonstrated its unique abilities by operating routinely on snow, ice, rough terrain, and doughy mud strips, even under high cross-wind conditions. The next phase of this effort will be an advanced development program to equip a C-130 aircraft with an air cushion landing gear system.

A low-pressure sidewall-convoluted (expandable) tire has successfully completed a series of simulated takeoff and landing taxi cycles. Substituting such an expandable tire for a standard aircraft tire will double the possible flotation footprint and greatly decrease the gear stowage volume.

Technical leadership has been provided by the laboratory in the development of high lift to drag (L/D) ratio reentry flight vehicles. Beginning with basic investigations in hypersonic aerodynamics in the mid-1950s, the laboratory performed exploratory development in all flight vehicle technology areas associated with these types of vehicles, such as high temperature structures, flutter and vibration at hypersonic speeds, aerothermodynamics and flight control problems. The Aerothermodynamic/Elas'' Structural Systems Environm Test (ASSET) Program, cons' six Thor missile-booster fr test vehicles launched fro

Canaveral (now Cape Kennedy) during the period of 1963 through 1965, was conceived and conducted under the direction of AFFDL. Velocities up to 19,500 feet per second and altitudes greater than 200,000 feet were attained in acquiring basic data on vehicle areodynamics and environmental effects on reradiating structures and materials. The overall program of the laboratory in research on hypersonic flight vehicles is continuing. A recently proposed program in the low-speed regime might consist of the construction and subsequent manned flight testing of an approximately 7,000-pound high L/D vehicle at Edwards AFB, Calif. The vehicle would be dropped from a B-52 flying at an altitude of 40,000 feet and Mach .65.

Solution of Operational Problems

The expertise attained by laboratory personnel provides the quick response capability needed for solution of Air Force operational problems. Some past examples of such problems include:

- Sonic fatigue on B-52 aircraft.
- Flow instability in the F-111 engine inlet.
- Vulnerability of Air Force aircraft to small arms fire.
- Wing crack propagation and fatigue life.
- Landing gear loads analysis and field experimentation.
- Improved flotation for tactical aircraft through tire deflation.
- Seat ejection injuries (Project Lifeline).
- AGM-12C structure/failure.

AFFDL personnel have participated in a number of aircraft review boards, such as the F-111, F-4, C-133 and B-58. An example of the application of the laboratory's capabilities to a particular weapon system problem was the F-111 engine-inlet compatibility study. A serious design deficiency restricted the operational envelope of this potentially important aircraft. Primary responsibility was given to the laboratory for isolating inlet problems and recommending changes. A comprehensive analysis of flight test and tunnel data was made to determine stall sensitivity with respect to flight Mach, angle of attack, engine airflow transients, inlet cowl and spike position, splitter plate and side plate behavior, and subsonic duct/compressor face pressure fluctuations. Causes of flow instability and pressure distortions were identified, and a series of inlet modifications to solve the problems were recommended.

The capability of the AFFDL inhouse experimental acoustic chamber to simulate high-intensity engine noise fields on components or fullscale flight vehicle structures makes possible unique contributions to the solution of operational problems, as well as the accomplishment of research and development objectives. Recent experimental programs include tests on such systems as the C-141, F-4C, F-4E, and F-111. Investigations of the acoustic fatigue resistance of new materials have involved filament structures, heat shields, and viscoelastic damped panel configurations. Inhouse exploratory development programs are serving to establish sonic fatigue design criteria for future structures. The demand for future acoustic test programs includes reliability experiments on Athena missile components, fatigue testing on the horizontal stabilizer of the EA-6A aircraft, and investigation of methods for reducing jet aircraft noise.

Resources available to AFFDL are, first and foremost, its military and civilian personnel, totaling 700 including over 400 scientists and engineers, of whom more than 100 hold advanced degrees. Total funds allotted to the laboratory in FY 1968 amounted to approximately $34 million. In-house experimentation and simulation facilities, used in carrying out the laboratory's mission, include a landing gear test facility (drop towers, dynamometers and a 1.4-million-pound tensile tester); a 50-megawatt hypersonic tunnel with a 30-minute run capability; a 2-foot supersonic tunnel; a large structures experimentation facility; a 1-megawatt acoustic test facility; a 12-foot diameter throat vertical wind tunnel; a complex of simulators for flight control experimentation; and equipment for combined vibration, temperature and "g" testing. The estimated replacement cost of the laboratory's facilities is $126 million.

As for the future, it is certain that, in the face of inflation and a relatively constant budget, selectivity will continue to be the keynote in determining the content of the laboratory program. The increasing cost and complexity, involved in conducting research and development and providing support for operational systems, requires even more effort to ensure that the critical future technical needs of the Air Force are discerned as early as possible and their solutions addressed the laboratory program. In this r gard, it is of interest to note that t capabilities of AFFDL were used the DOD test laboratory for Proje TORQUE (Technology or Resear Quantitative Utility Evaluation), experimental system for aiding labo atory and Service management structuring a research and develo ment program responsive to specifi Service objectives.

In summary, the Air Force Flig Dynamics Laboratory provides tl Air Force and the Defense Depar ment, as well as industry, experience interdisciplinary scientists and eng neers who conduct programs designe to solve tomorrow's problems and pro vide a technology base which will pre clude, to the greatest extent possibl the occurrence of these problems.

USACSC Establishes Two Support Groups

The U.S. Army Computer Sys tems Command (USACSC) ha added two new field organizations t its command. The new USACS Support Groups are located at th Presidio, San Francisco, Calif., an Fort Eustis, Va.

The Presidio support group was or ganized from personnel transferre from the Sixth Army Stock Contro Center, Presidio, and is responsibl for the continued development fielding and support of the Centrali zation of Supply Management Opera tions Systems (COSMOS). COSMO is a centrally designed system whic will perform supply management an related techniques and communica tions via the AUTOVON and AU TODIN systems.

The second USACSC suppor group was organized around per sonnel transferred from the U.S. Con tinental Army Command Automate Systems Support Agency (CASSA) Fort Eustis, Va. Their responsibilit is with the Continental Army Com mand Class I Automated Syster (COCOAS), designed to provid standard automatic data processin programs and hardware at installa tion level to meet management re porting requirements for financial, lo gistical and personnel data. A proto type system is currently in operatio at Fort Sill, Okla.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Dr. Gardiner L. Tucker has assumed duties as Principal Dep. Dir., Defense Research and Engineering.

Lt. Gen. (designee) Timothy F. O'Keefe, USAF, has been selected for Dir. for Logistics, Office of the Joint Chiefs of Staff, Washington, D.C.

Lt. Gen. (designee) John W. Vogt Jr., USAF, is now Dir. for Operations, Office of the Joint Chiefs of Staff, Washington, D.C.

Dr. Donald B. Rice Jr. has been designated Dep. Asst. Secretary, Resources, Office of the Asst. Secretary of Defense (Systems Analysis).

Maj. Gen. Wendell E. Carter, USAF, Dep. Asst. Secretary of Defense, Information, Office of the Asst. Secretary of Defense (Comptroller), has retired.

Brig. Gen. (designee) Floyd H. Trogden, USAF, is the new Dep. Dir., Programs, Defense Communications Agency, Arlington, Va.

Col. Roger Ray, USA, has been designated Dep. Asst. to the Secretary of Defense, Atomic Energy.

The Defense Supply Agency, Alexandria, Va., has announced the following changes: Maj. Gen. Daniel E. Riley, USAF, assigned as Asst. Dir., Plans, Programs and Systems; Brig. Gen. John A. Brooks III, USAF, former Exec. Dir., Technical and Logistics Services, has retired; Brig. Gen. Robert E. Lee, USAF, former Exec. Dir., Procurement and Production, has retired; Col. Henry M. Fletcher Jr., USAF, assigned as Exec. Dir., Contract Administration Directorate; and Capt. Jerome J. Scheela, SC, USN, assigned as Dep. Comptroller.

DEPARTMENT OF THE ARMY

The Army Strategic Communications Command, Fort Huachuca, Ariz., has announced the following changes in command: Maj. Gen. Hugh M. Foster has taken command of STRATCOM-Pacific, Honolulu, Hawaii. He replaces Brig. Gen. Robert D. Terry, who became Dep. Dir., National Military Command System Support, Defense Communications Agency, Washington, D.C. Brig. Gen. Irving R. Obenchain has assumed duties as Commander, STRATCOM Safeguard Communications Agency, Fort Huachuca.

Mr. Leo Rachmel has been named Chairman of the newly formed Research Development Test and Evaluation Dept., Army Logistics Management Center, Fort Lee, Va.

Col. Ernest H. Davis is the new Dir., Concepts and Plans, Combat Developments Command, Fort Belvoir, Va.

The new Pershing Project Manager, Army Missile Command, Redstone Arsenal, Ala., is Col. Rutledge P. Hazzard.

Col. Russell J. Lamp has been assigned to the Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., as Commanding Officer.

Capt. Alfred W. Swan, SC, USN, has replaced Col. Norman H. Gold, USA, as Dir. of Freight Management, Military Traffic Management and Terminal Service, Washington, D.C.

DEPARTMENT OF THE NAVY

RAdm. Malcolm W. Cagle has been appointed Dir., General Planning and Programming Div., Office of the Chief of Naval Operations. RAdm. George S. Morrison has been chosen Dir., Electronic Warfare and Tactical Command Systems Div., Office of the Chief of Naval Operations.

RAdm. George E. Moore II, SC, replaces RAdm. Nathan Sonenshein as Dep. Chief of Naval Materiel (Logistic Support). RAdm. Sonenshein is the new Commander, Naval Ship Systems Command, Washington, D.C.

RAdm. Kenneth R. Wheeler, SC, has been assigned as Vice Commander, Naval Supply Systems Command.

RAdm. Mark W. Woods has moved up from Vice Commander, Naval Ordnance Systems Command, to Commander. The new Vice Commander is RAdm. Frank H. Price Jr.

Capt. Albion W. Walton, CEC, has been named Dep. for Acquisition, Naval Facilities Engineering Command, Washington, D.C.

Capt. Wayne J. Christensen is the new Commander, Northeastern Div., Naval Facilities Engineering Command, Boston, Mass. Capt. Ralph B. Grahl, CEC, has been named Commander, Eastern Div., Naval Facilities Engineering Command, New York, N.Y.

Capt. Donald A. Hempson, SC, has been assigned as Commander, Fleet Material Support Office, Mechanicsburg, Pa.

Capt. Frederick F. Jesett II has replaced Capt. Eugene H. Simpson as Commander, Naval Weapons Station, Seal Beach, Calif.

DEPARTMENT OF THE AIR FORCE

Lt. Gen. John W. Carpenter III has been reassigned as Asst. Vice Chief of Staff, Hq. USAF. His replacement as Dep. Chief of Staff, Personnel, is Lt. Gen. Austin J. Russell.

Lt. Gen. Robert G. Ruegg has replaced Lt. Gen. Robert A. Breitweiser as Commander in Chief, Alaskan Command. Lt. Gen. Breitweiser has retired.. Lt. Gen. (designee) Harry E. Goldsworthy has succeeded Lt. Gen. Ruegg as Dep. Chief of Staff, Systems and Logistics, Hq. USAF. Maj. Gen. Donald W. Graham is the new Asst. Dep. Chief of Staff, Systems and Logistics, Hq. USAF.

Lt. Gen. (designee) George B. Simler has been reassigned as Vice Commander in Chief, USAF Europe.

Hq., USAF, also announced the following changes: Lt. Gen. Lucius D. Clay has replaced Lt. Gen. Glen W. Martin as Dep. Chief of Staff, Plans and Operations. Gen. Martin is now Vice Commander in Chief, SAC, Offut AFB, Neb. Mr. John J. Welch Jr. has taken the position of Chief Scientist, Office of the Chief of Staff. Dr. John C. Fisher, former Chief Scie tist, has left government service. Lt. Gen. (designee) George S. Boylan Jr. has been named Dep. Chief of Staff,

Programs and Resources. **Maj. Gen. John M. McNabb** is the new Dir. of Plans, Office of the Dep. Chief of Staff, Plans and Operations, and **Maj. Gen. Andrew S. Low Jr.** has moved from Asst. for Logistics Planning, Office of the Dep. Chief of Staff, Systems and Logistics, to Dir. of Aerospace Programs, Office of the Dep. Chief of Staff, Programs and Resources. His replacement is **Brig. Gen. Peter R. Delonga. Maj. Gen. Edward M. Nichols Jr.** is now Dep. Inspector General for Inspection, Office of the Inspector General, Norton AFB, Calif. He replaces **Maj. Gen. Richard O. Hunziker**, who retired.

Maj. Gen. William C. Garland, former Dir., Office of Information, Office of the Secretary of the Air Force, has taken command of the First Strategic Aerospace Div., SAC, Vandenburg AFB, Calif. His replacement is **Brig. Gen. Henry L. Hogan III**, formerly Dep. Dir. The new Dep. Dir. of the Office of Information is **Brig. Gen. Thomas P. Coleman.**

Brig. Gen. Lew Allen Jr. is now Dir., Office of Space Systems, Office of the Secretary of the Air Force.

Maj. Gen. William H. Brandon is the new Dep. Dir. for Civil Disturbance Planning and Operations, Pentagon, Washington, D.C.

The Air Force Systems Command, Andrews AFB, Md., announced the following changes: **Lt. Gen. John W. O'Neill** became Vice Commander, AFSC, on Sept. 1 replacing **Lt. Gen. Charles H. Terhune Jr.** who has retired. **Lt. Gen. Samuel C. Phillips** replaced Lt. Gen. O'Neill as Commander, Space and Missile Systems Organization. **Brig. Gen. John B. Hudson** replaced **Maj. Gen. Vincent G. Huston** as Dep. Chief of Staff, Operations, AFSC. **Brig. Gen. David V. Miller** has moved from Commander, Special Weapons Center, Kirtland AFB, N.M., to Dep. Chief of Staff, Personnel, AFSC. **Col. Edward R. Feicht** has succeeded **Col. Edwin W. Brown** as Vice Commander, Arnold Engineering Development Center, Arnold AFS, Tenn.

Brig. Gen. Ralph T. Holland is the new Vice Commander, Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga., and **Col. Charles J. Beck** has replaced **Brig. Gen. Jowell C. Wise** as Vice Commander, Ogden Air Materiel Area, AFLC, Hill AFB, Utah. Brig. Gen. Wise retired.

AFSC Realigns F–15 Program

The Air Force Systems Command, Andrews AFB, Md., has announced several organizational changes in the F–15 program directed at strengthening management and streamlining channels.

The Systems Program Director, located at Wright-Patterson AFB, Ohio, will report directly to the Commander, AFSC, instead of being subordinate to AFSC's Aeronautical Systems Division. No physical move is involved, however, and the Aeronautical Systems Division will continue to support the program.

Simultaneously, Brigadier General (designee) Benjamin N. Bellis has been assigned to direct the program, in line with Air Force practice to put major systems development 'under general officer supervision. Colonel Bob White, who organized and directed the Systems Program Office from its inception, will continue as General Bellis' deputy.

The third change involves the transfer of the F–15 monitoring responsibility from the Pentagon to AFSC headquarters. Colonel R. K. McIntosh has been named to fill the new position, Assistant to the Commander for the F–15, with the responsibility for F–15 matters in the Washington area.

Army Engineers Test Plastic Sealed Roads

Plastic-wrapped roads, designed to cut costs and construction time in combat areas, are under test by the Army Corps of Engineers. The plastic wrapper enables road builders to substitute fine grain subgrade materials, such as clay soils native to a road site, for a granular base, eliminating locating and quarrying rock, crushing it, and hauling it to the road site.

The wrapper, actually polypropylene fibers inserted into a cotton scrim, is made in 15-by-300-foot sections. In use, the plastic is laid over the prepared roadbed, and covered with a layer of asphalt and subgrade material. This sandwich is then compacted and covered with a second layer of plastic. The two layers of polypropylene are then sealed, covered with a final layer of asphalt, and the road is ready for use.

The plastic, according to Corp spokesmen, acts as a waterproof sea against subsurface moisture seepin up and as a reinforcement for th asphalt, permitting much greater de flection under traffic than asphal alone.

The concept is undergoing tests a the Corps Waterways Experiment Station, Vicksburg, Miss., and at Dyes AFB, Tex. At Vicksburg, a membrane encasement has been successfully tested with military convoy traffic of 2½- and 5-ton cargo trucks. In another test, an 18-inch layer of clay sealed in the membrane supported 2,000 passes of a 25,000-pound single wheel load.

The tests, according to the Corps, indicate that the combination of polypropylene and asphalt can be used for waterproofing and dustproofing roads, street hardstands and even air terminals.

Army Unveils New Air Target System

A new Ballistic Aerial Target System (BATS) for Redeye, Chaparral and Vulcan training has been proposed for procurement by the Army Combat Developments Command (CDC), Fort Belvoir, Va. BATS would provide a low-cost, troop-operated, booster-propelled aerial target system offering realistic training for forward area air defense systems, present and future.

CDC envisions BATS as having a portable launcher, enabling emplacement by troops within two hours, using unit hand tools. In flight, BATS would be capable of maintaining stable flight and structural integrity at three intermediate speeds between 300 and 500 knots.

With a broadside target area of 30 square feet, BATS would have a hit determination indicator for gunner evaluation, and possess an infrared signature compatible with Redeye and Chaparral missile systems. BATS could also have a self-destruct device, sensitive to excessive deviation from a safe trajectory, if deemed necessary during early tests.

Finally, BATS would be operable in all climates, having a maximum range of 12,000 feet at 2,000 feet altitude, and have a troop training time of under 8 hours.

MEETINGS AND SYMPOSIA

SEPTEMBER

Seventh Annual Defense and Government Procurement Conference, Sept. 4-5, at the Rackham Memorial Building, Detroit, Mich. Sponsor: Defense and Government Contracts Management Association. Contact: Frank R. Light, Conference Chairman, Exec. Vice President, Continental Aviation and Engineering, Div. of Continental Motors Corp., 12700 Kercheval Ave., Detroit, Mich. 48215.

Advanced Planning Briefing for Industry on Naval Aeronautics/Astronautics (classified), Sept. 23-25, at Battelle Memorial Institute Columbus Laboratories, Columbus, Ohio. Co-sponsors: Naval Material Command and National Security Industrial Association. Contact: Paul A. Newman, National Security Industrial Association, 1030 15th Street NW, Suite 800, Washington, D.C. 20005. Phone (202) 296-2266.

V/STOL Technology and Planning Conference, Sept. 23-25, Las Vegas, Nev. Sponsor: Air Force Flight Dynamics Laboratory. Contact: Lt. Col. Jay D. Pinson, Conference Chairman, Dir., V/STOL Division, Flight Dynamics Laboratory, AFSC, Wright-Patterson AFB, Ohio 45433.

OCTOBER

Fifty-first Defense Preparedness Meeting, Oct. 1-2, at The Sands Hotel, Las Vegas, Nev. Co-sponsors: American Ordnance Association and U.S. Air Force. Contact: Col. John R.V. Dickson, American Ordnance Association, Transportation Building, 816 17th Street NW, Washington, D.C. 20006. Phone (202) 347-7250.

Biological Molecules in Their Excited States Symposium, Oct. 5-9, at Columbia University, New York, N.Y. Sponsors: U.S. Army Research Office-Durham, Hoffman-La Roche, and the American Instrument Company. Contact: Dr. George M. Wyman, Director, Chemistry Division, U.S. Army Research Office-Durham, Box CM, Duke Station, Durham, N.C. 27706. Phone (919) 286-2285.

International Blood Oxygenation Symposium, Oct. 6-8, at the University of Cincinnati, Ohio. Co-sponsors: U.S. Army Medical Research and Development Command, and the College of Engineering, University of Cincinnati. Contact: Col. Lawrence R. Rose, MC, Chief, Surgical Research Division, U.S. Army Medical Research and Development Command, Washington, D.C. 20315. Phone (202) OXford 6-6082.

Annual Association of the United States Army Meeting, Oct. 13—15, Sheraton-Park Hotel, Washington, D.C. Sponsor: Association of the United States Army. Contact: Brig. Gen. Robert F. Cocklin, USAR, Association of the United States Army, 1529 18th St., NW, Washington, D.C. 20036. Phone (202) 483-1800.

Configuration Management Workshop, Oct. 20-24, at Shelbourne Hotel, Atlantic City, N.J. Sponsor: Electronic Industries Association. Contact: Jack F. Hessman, Electronic Industries Association, 2001 I Street NW, Washington, D.C. 20006. Phone (202) 659-2200.

Fifteenth Design of Experiments in Army Research, Development and Testing Conference, Oct. 22–24, Redstone Arsenal, Ala. Sponsors: U.S. Army Research Office-Durham, and the Army Mathematics Steering Committee of the Office of the Army Chief of Research and Development. Contact: Dr. Francis G. Dressel, Mathematics Division, U.S. Army Research Office—Durham, Box CM, Duke Station, Durham, S.C. 27706. Phone (919) 286–2285, Ext. 75.

EASCON '69 Electronics and Aerospace Systems Convention and Exposition, Oct. 27-29, at the Sheraton Park Hotel, Washington, D.C. Sponsor: Aerospace and Electronic Systems Group, Institute of Electrical and Electronics Engineers. Contact: Robert M. Johnson, General Electric, 777 14th Street NW, Washington, D.C. 20005. Phone (202) 393-3600, Ext. 207; or Col. James M. Templeman, Office of Assistant Chief of Staff, Communications & Electronics, Department of the Army, 2E 268 Pentagon, Washington, D.C. 20310. Phone (202) OXford 7-1279.

NOVEMBER

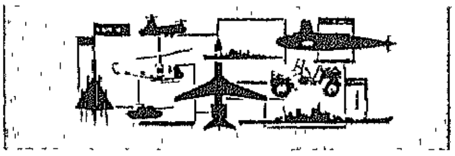
Second Annual Armed Forces Audio-Visual Communications Conference, Nov. 3-7, at the Sheraton-Park Hotel, Washington, D.C. Sponsor: Department of the Army. Contact: HQUSAF (AFXO-TV), 2AFAVCC Registration Committee, Washington, D.C. 22030. Phone (202) 693-2615.

Fifteenth Annual Army Human Factors Research and Development Conference, Nov. 4-6, at Fort Ord, Calif. Sponsor: Behavorial Sciences Division of the Office of the Chief of Army Research and Development. Contact: Lynn E. Baker, U.S. Army Chief Psychologist, Behavorial Sciences Division, Office of the Chief of Research and Development, Department of the Army, Washington, D. C. 20310. Phone (202) OXford 4-3693.

VTOL Environmental Requirements Symposium, Nov. 17-18, at Arlington, Tex. Sponsors: Aeronautical Systems Division (AFSC), American Helicopter Society, and the University of Texas. Contact: Mr. Kuehne, Aeronautical Systems Division (ASZT), Wright-Patterson AFB, Ohio 45433. Phone (513) 255-3224.

Fourth Naval Training Device Center and Industry Cost Effective Training Devices Conference, Nov. 18-20, at the Naval Training Center, Orlando, Fla. Sponsor: Naval Training Device Center. Contact: D. Robert Copeland, Conference Coordinator, Code 421, Naval Training Device Center, Orlando, Fla. 32813. Phone (305) 841-5611 Ext. 664.

Titanium Technical Conference, Nov. 18-20, at Dayton, Ohio. Co-sponsors: Air Force Materials Laboratory and the University of Dayton Research Institute. Contact: Dr. Gegel, Air Force Materials Laboratory (MAMS), Wright-Patterson AFB, Ohio 45433. Phone (513) 255-5561.



DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of July 1969.

DEFENSE SUPPLY AGENCY

1—The Defense General Supply Center, Richmond, Va., awarded the following contracts for sandbags:

Crowley Industrial Bag Co., Inc. Crowley, La. $3,030,388. 4,790,000 polypropylene and 10,000,000 acrylic. DSA 400-70-C-0009.

Consolidated Bag Corp., Philadelphia, Pa. $2,322,540. 9,200,000 acrylic. DSA 400-70-C-0005.

Kane Bag Supply Co., Baltimore, Md. $1,731,925. 5,000,000 polypropylene and 5,000,000 acrylic. DSA 400-70-C-0006.

Bemis Co., Inc., Minneapolis, Minn. $1,033,908. 2,540,000 polypropylene and 3,000,000 acrylic. Norfolk, Va., and New Orleans, La. DSA 400-70-C-0008.

7—Humble Oil Refining Co., Houston, Tex. $1,483,100. Fuel oil and gasoline. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-2868.

—Kentucky Appalachian Industries, Inc., Prestonsburg, Ky. $1,133,384. Wet weather parkas. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0017.

—Brownwood Manufacturing Co., Dallas, Tex., $1,077,468. Men's raincoats for the Air Force. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0016.

8—Burlington Industries, Inc., New York, N.Y. $2,801,830. 961,000 yards of Air Force Blue serge cloth. Raeford, N.C., Halifax and Clarksville, Va. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0001.

9—Consolidated Bag Corp., Philadelphia, Pa. $2,312,031. 9,200,000 acrylic sandbags. Defense General Supply Center, Richmond, Va. DSA 400-70-C-0005.

—Kane Bag Supply Co., Baltimore, Md. $1,837,427. 5,000,000 polypropylene and 5,000,000 acrylic sandbags. Defense General Supply Center, Richmond, Va. DSA 400-70-C-0006.

—United Bag, Inc., St. Louis, Mo. $1,011,662. 4,000,000 acrylic sandbags. Defense General Supply Center, Richmond, Va. DSA 400-70-C-0004.

11—Hess Oil and Chemical Corp., Woodbridge, N.J. $2,973,661. Fuel oil and gasoline for delivery to installations in the East. Defense Fuel Supply Center, Alexandria, Va. DSA 600-09-D-2300.

—Gulf Oil Corp., Houston, Tex. $6,342,769. Fuel oil and gasoline for delivery to installations in the East. Defense Fuel Supply Agency, Alexandria, Va. DSA 600-69-D-2304.

—Genesco, Inc., Nashville, Tenn. $1,106,842. 166,668 pairs of men's black oxford dress shoes. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0075.

18—Singleton Packing Corp., Tampa, Fla. $1,042,214. 95,616 cans of cooked, dehydrated shrimp. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-70-C-E002.

CONTRACT LEGEND

Contract information is listed in the following sequence: Date — Company — Value — Material or Work to be Performed—Location of Work Performed (if other than company plant) — Contracting Agency—Contract Number.

22—Rachman Manufacturing Co., Reading, Pa. $2,560,219. 110,880 body armor fragmentation protective vests for the Republic of Vietnam Armed Forces. Defense Personnel Support Center, Philadelphia, Pa DSA 100-70-C-0126.

—Lester D. Lawson and Co., Long Beach, Calif. $4,564,657. 163,140 cases of ration supplement, sundries pack. Brookley AFB, Ala. Defense Personnel Support Center, Philadelphia, Pa DSA 134-70-C-0032.

24—Stauffer Chemical Co., New York, N.Y. $2,986,140. 3,140,000 one-quart cans of aircraft turbine lube oil. Gallipolis Ferry, W. Va. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-C-0233.

25—Chevron Oil Co., Perth Amboy, N.J. $1,042,694. Various quantities of fuel and gasoline for installations in New England. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-D-0011.

—Gulf Oil Co., Houston, Tex. $1,346,322. Fuel oil and gasoline for installations in New England. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-C-0033.

—Union Oil Co. of Boston, Revere, Mass. $1,148,509. Fuel oil and gasoline for installations in New England. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-D-0083.

—Henderson Manufacturing Co., Inc., Lumberton, N.C. $1,011,050. 365,000 men's wind-resistant cotton coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0155.

31—MacShore Classics, Inc., New York, N.Y. $1,365,000. 500,000 men's cotton coats. Woodruff, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0208.

—Cavalier Bag Co., Inc., Lumberton, N.C. $2,345,220. 9,000,000 acrylic sandbags. Defense General Supply Center, Richmond Va. DSA 400-70-C-0008.

—Pembroke, Inc., Egg Harbor City, N.J. $1,008,008. 42,532 men's wool serge overcoats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0182.

—Sparling Mills, Inc., Greenville, R. I. $1,011,360. 4,000,000 acrylic sandbags. Lumberton, N.C. Defense General Supply Agency, Richmond, Va. DSA 400-70-C-0447.

DEPARTMENT OF THE ARMY

1—Martin Marietta Corp., Orlando, Fla. $4,111,387. Modification kit installation and modified equipment training for the Pershing. Army Missile Command, Huntsville, Ala. DA-AHO1-70-C-0005.

—Control Data Corp., Honolulu, Hawaii. $3,500,000. Development and analysis in support of the Military Assistance Command, Vietnam pacification program. Work will be done in Vietnam. Army Missile Command, Huntsville, Ala. DA-AHO1-70-C-0009.

—Raytheon Co., Andover, Mass. $1,982,422. Basic Hawk engineering services product assurance, practice field facilities and an improvement team. Army Missile Command, Huntsville, Ala. DA-AHO1-70-C-0384.

—IBM Corp., Gaithersburg, Md. $2,105,948. (contract modification). Combat services support system. Army Electronics Command, Alexandria, Va. DA-AB07-67-C-0408.

—Kentron, Hawaii, Ltd., Honolulu, Hawaii. $1,656,166. Specialized services to support maintenance and calibration standards of test equipment in the Pacific Theater. Vietnam, Thailand and Okinawa. Army Purchasing and Contracting Office, Hawaii. DA-GA01-69-C-0357.

—Nurrie Construction Co., Muskogee, Okla. $1,034,731. Construction of recreational facilities in Jefferson County, Kansas. Army Engineer District, Kansas City, Mo. DA-CW41-70-C-0001.

2—LTV Electrosystems, Inc., Huntington, Ind. $8,554,746. Components of AN/VRC-12 vehicular radio sets for tactical use. Army Electronics Command, Philadelphia, Pa. DA-AB05-67-C-0171.

—Urban Systems Development Corp., Arlington, Va. $3,724,002. Construction of 200 family housing units, Fort Meade, Md. Army Engineer District, Baltimore, Md. DA-CA31-70-C-0001.

—Sylvania Electric Products, Inc., Williamsville, N.Y. $2,246,000 (contract modification). Burn-in spare parts for AN/ARC-114, 115 and 116 radio sets and AN/ARN-80 automatic direction finder. Buffalo, N.Y. Army Electronics Command, Fort Monmouth, N.J. DA-28-043-AMC-01943(E).

3—Sides Construction Co., Omaha, Neb. $1,051,526. Alterations to Headquarters Building, Offut AFB, Neb. Army Engineer District, Omaha, Neb. DA-CA45-70-C-0003.

7—Firestone Tire and Rubber Co., Akron, Ohio. $1,269,500. Road wheel assemblies for the M113 armored personnel carriers. Noblesville, Ind. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-5144.

—Goodyear Tire and Rubber Co., Akron, Ohio. $1,076,470. Track shoe assemblies for M108 and M109 howitzers. St. Mary's, Ohio. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4492.

9—Bell Helicopter Co., Fort Worth, Tex. $1,898,248. Rotary rudder blades for UH-1 helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

—Riddle Contracting Co., Salina, Kan. $1,273,290. Construction and excavation work, Douglas and Leavenworth Counties, Kan. Army Engineer District, Kansas City, Mo. DA-CW41-70-C-0002.

10—General Electric Co., Portland, Ore. $4,049,000. Fabrication and installation of 135-MW generators at the John Day Lock and Dam, near Dalles, Ore. Army Engineer District, Walla Walla, Wash. DA-CW68-70-C-0007.

—Gregg, Gibson and Gregg, Inc., Leesburg, Fla. $1,676,687. Construction of a spillway structure and approximately one mile of canal, and raising 900 feet of levee in connection with the Central and Southern Florida Project, Okeechobee County, Fla. Army Engineer District, Jacksonville, Fla. DA-CW17-70-C-0004.

11—Mohawk Rubber Co., Akron, Ohio. $1-285,428. 12-ply rubber tires for 5-ton trucks. West Helena, Ark., and Salem, Va. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-0002.

15—Mine Safety Appliances Co., Pittsburgh, Pa. $4,793,071. Second and third increment of multi-year procurement of protective field masks. Esmond, R. I. Edgewood Arsenal, Md. DA-AA15-67-C-0265.

—Rubin Construction Co., West Palm Beach, Fla. $2,637,193. Excavation of 4½ miles of canal from the southwest side of Lake Okeechobee through Moorehaven, Fla. Army Engineer District, Jacksonville, Fla. DA-CW17-70-C-0006.

16—A. G. Schoonmaker, Inc., Sausalito, Calif. $1,236,910. Diesel generator sets. Army Engineer District, San Francisco, Calif. DA-CA07-70-C-0005.

—Missouri Research Laboratories, St. Charles, Mo. $1,083,498 (contract modification). Service ward units (MUST hospital). Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-68-C-8162.

17—Harvey Aluminum Sales, Inc., Torrance,

$1,736,608 (contract modification). expansion, and conversion and of non-production equipment, Ammunition Plant, Milan, Tenn ammunition Procurement and Supply Agency, Joliet, Ill DA-11-173-AMC-

Parker, Inc., Marysville, Calif. Bank protection work on the Rivei between Sacramento Walle Weii, Calif. Army Engineer Sacramento, Calif DA-CW05-70-

on Construction Co., Minneapolis, 850,743 Construction of intake and tunnel liners at Carter's Army Engineer District, Mobile, CW01-70-C-0008

Electronics, Inc., New Bedford, 022,282 (contract modification). 25 radio sets. Army Electronics Philadelphia, Pa. DA-36-0390-06(E).

Inc., Hartford, Conn. $41,158,294. M-16 rifles. Army Weapons Com- Rock Island, Ill. DA-AF03-70-C-

Motors Corp., Ypsilanti, Mich. 66. 229,217 M-16 rifles. Army Weapons Command, Rock Island, Ill. DA-AF03-

others, Stockton, Calif. $1,661,652 modification). 200 general purpose generator sets. Army Mobility Equipment Command St. Louis, Mo. DA-AK01-

Corp., Charleston, S.C. $5,323,500. and/or repair of T53-L-13/13A engines for UH-1H and AH-1G Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0308.

ugh Products, Inc., Hampton, Va. 400. Metal parts for 152mm projectiles (XM409E2). Picatinny Arsenal, DA-AA21-70-C-0045.

Case Western Reserve University, Cleveland, Ohio. $1,500,000. Computer research and development. Army Electronics Command, Fort Monmouth, N.J.

Van Nuys, Calif. $1,653,010. Signal for the AN/ASH voice warning and signal adapter test sets. Army Electronics Command, Fort Monmouth, DA-AB07-70-C-0024.

Helicopter Co., Fort Worth, Tex. 8,309. OH-58A light observation copters and related data. Hurst, Tex., Beech Aircraft Corp., Wichita, Kans. Aviation Systems Command, St. Mo. DA-AJ01-68-C-1609.

rn Electric Co., Inc., New York, $4,300,000. Installation of kits for Nike Hercules weapon system at locations. Army Missile Command, Huntsville, Ala. DA-AH01-68-A-

ental Motors Corp., Muskegon, Mich. 720. Cylinder assemblies for engines -60 tanks. Muskegon and Oberdorfer rles, Inc., Syracuse, N.Y. Army Tank Automotive Command, Warren, Mich. DA-69-C-4841.

Systems, Inc., Sunnyvale, Calif. 000 (contract modification). Scientific and technical effort to support experimentation for the Combat Developments Command, Experimental Command, Ord, Calif., and Hunter-Liggit Military Reservation, King City, Calif. San Francisco Procurement Agency, Pasadena, DA-AG05-67-C-3096(X).

Graves and Sons Co., Ann Arbor, $3,106,731. Relocation of 4½ miles and township roads in Erie Pa., in connection with the Union Reservoir Project. Army Engineer Pittsburgh, Pa. DA-CW59-70-C-

Manufacturing Co., Ebensburg, $1,726,674 (contract modification). water tank trailers. Army Tank Automotive Command, Warren, Mich. DA-69-C-1461.

Aircraft Corp., Plainfield, N.J. 666. AN/VPS-2 radars and XM163 on kits for the Vulcan Air Defense System. Army Procurement Agency, York, N.Y. DA-AA25-69-C-0196.

Electric Co., New York, N.Y. 000. Research and development contract extension for Safeguard studies Sept. 15.

Motor Co., Dearborne, Mich. $2,034,- contract modification). Engineering for M151 and M718 series trucks. Tank Automotive Command, Warren. DA-AE07-68-C-2908.

Head Co., Cleveland, Ohio. $1,578,-000(contract modification). Metal parts for 105mm projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-AA09-69-C-0115

—CONDEC Corp., Old Greenwich, Conn $1,503,300 (contract modification). Engineering services in support of production of the M561 truck (Gamma Goat). Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-0144

—Bell Aerospace Corp., Fort Worth, Tex $1,482,546. Rotary wing hubs for UH-1 helicopters, Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314

—General Time Corp., Stamford, Conn. $1,-463,200 (contract modification). Metal parts for 105mm through 155mm artillery shells. Thomaston, Ga Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0409.

—Hughes Aircraft Co., Culver City, Calif. $1,304,718. TOW missile research and development. Army Missile Command, Huntsville, Ala. DA-AH01-70-C-0097.

—General Motors Corp., Indianapolis, Ind. $1,187,025 (contract modification). T-63 turbine engines for light observation helicopters. Army Aviation Systems Command, St. Louis, Mo DA-AJ01-69-C-00140.

—Standard Container Co., Montclair, N.J. $1,106,215 (contract modification). Ammunition packaging boxes for .30 caliber and 7.62mm linked ammunition. Homerville, Ga. Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C-0308.

—Hayes International Corp., Birmingham, Ala. $1,094,944. Metal parts for M151 (2.75 inch rocket) warheads. Cincinnati Procurement Agency, Cincinnati, Ohio. DA-AA09-69-C-0135.

DEPARTMENT OF THE NAVY

1—Airborne Instruments Laboratory, Inc., Long Island, N.Y. $18,113,010. Aircraft carrier aircraft approach control system equipment. Deer Park, N.Y. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1300.

—Westinghouse Electric Corp., Washington, D.C. $16,931,250. Poseidon launcher and handling equipment. Sunnyvale, Calif. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0138.

—Raytheon Co., Lexington, Mass. $9,000,-000. Production of AN/SPG-51D dual radar sets and ancillary equipment for Tartar D missiles. North Dighton, Mass. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2409.

—Hazeltine Corp., Little Neck, N.Y. $5,833,-930. AN/AGSQ-141/142 acoustic-seismic detection transmitting sets for the Army and Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0617.

—Sperry Rand Corp., St. Paul, Minn. $2,-533,311. Research and development on airborne navigation systems. Naval Air Systems Command, Washington, D.C. N00019-69-C-0695.

—Clevite Corp., Cleveland, Ohio. $1,500,000. Production of Mk 48 Mod 1 torpedo, components, and associated equipment. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-1420.

—IBM Corp., Arlington, Va. $1,348,426. Computer equipments and services for seven Naval Industrial Air Stations. Naval Automatic Data Processing Equipment Systems Office, Washington, D.C. 1066032-62-L-0007.

—The Naval Ship Systems Command, Washington, D.C., awarded the following contracts for definition efforts on the AN/BQs submarine sonar system:

Raytheon Co., Portsmouth, R. I. $1,250,-000. N00024-69-C-1452.

Sperry Rand Corp., $1,150,000. N00024-69-C-1453.

IBM Corp., Owego, N.Y. $1,099,420. N00024-69-C-1454.

General Electric Co., Syracuse, N.Y. $1,200,000. N00024-69-C-1455.

2—Collins Radio Co., Richardson, Tex. $4,-863,961. Various components for use in the Naval Tactical Data System. Richardson and Cedar Rapids, Iowa. Naval Ship Systems Command, Washington, D.C. NObsr-95244.

—Newport News Shipbuilding and Dry Dock Co., Newport News, Va $22,013,670 (contract modification). Overhaul, refueling and alteration of USS Daniel Webster (SSBN 626) Naval Ship Systems Command, Washington, D.C. N00024-68-C-0308

—Raytheon Co., Lexington, Mass. $18,171,-030. Sparrow III guidance and control groups for the Navy and Air Force. Lowell and Bedford, Mass., Oxnard, Calif., and Bristol, Tenn N00019-68-C-9386. $5,-626,244. Sparrow III guidance and control sections. N00019-68-C-0336. Naval Air Systems Command, Washington, D.C.

—Hazeltine Corp., Little Neck, N.Y. $4,667,-144. Classified electronic equipment. Naval Air Systems Command, Washington, D.C. N00019-69-C-0617.

—North American Rockwell Corp., McGregor, Tex. $2,040,698. Rocket motors for Shrike and Sparrow missiles. Naval Air Systems Command, Washington, D.C. N00019-69-C-0215.

—LTV Aerospace Corp., Dallas, Tex. $1,-347,120. TF-41-A-2 engine flight tests. Naval Air Systems Command, Washington, D.C. N00019-68-C-0075.

3—Johns Hopkins University, Silver Spring, Md. $3,419,900. Increase the level of effort on advanced research on surface missile system Naval Ordnance Command, Washington, D.C. NOW62-0604-C.

—Vitro Corp. of America, Silver Spring, Md. $1,987,178. Increase in engineering services and support for surface missile systems. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-4415.

—Westinghouse Electric Corp., Baltimore, Md. $1,500,000. Engineering support for Mark 48 torpedo. Landsdowne, Md. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-0162.

—Cates Construction Co., Inc., Dallas, Tex. $1,104,000. Construction of bachelor enlisted quarters, Naval Air Station, Chase Field, Tex. Naval Facilities Engineering Command, Washington, D.C. N62468-69-C-0162.

7—FMC Corp., Minneapolis, Minn. $22,683,-105. Mark 13, Mods 1 and 3, guided missile launching systems and ancillary equipment. Fridley, Minn. Naval Ordnance Systems Command, Washington, D.C. N0001.-69-C-2208.

—General Electric Co., Pittsfield, Mass. $4,-389,000. Poseidon missile training system services and material. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0128.

—Transit Tank International Inc., Richmond, Calif. $1,805,751. Petroleum asphalt. Naval Purchasing Office, Los Angeles, Calif. N00123-69-C-1674.

—Norris Industries, Vernon, Calif. $1,791,-739. War heads and motor cases for five-inch 38 caliber projectiles. Naval Ordnance Station, Indian Head, Md. N00174-70-C-007.

—Sylvania Electronic Systems, Inc., Mountain View, Calif. $1,471,500. Classified electronic equipment. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1447.

—McDonnell Douglas Corp., St. Louis, Mo. $356,713,045. F-4J, RF-4C and F-4E aircraft for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0521.

—Boeing Co., Morton, Pa. $33,123,630. CH-46D helicopters. Naval Air Systems Command, Washington, D.C. N00019-69-C-0502.

—Grumman Aircraft Engineering Corp., Bethpage, N.Y. $9,680,700 (contract modification). Modification kits for the E-2A aircraft program. Naval Air Systems Command, Washington, D.C. N00019-67-C-0657.

—Collins Radio Co., Cedar Rapids, Iowa. $6,626,502. Airborne communication, navigation and identification equipment components. Naval Air Systems Command, Washington, D.C. N00019-69-C-0527.

—Hughes Aircraft Co., Culver City, Calif. $4,740,305 (contract modification). Phoenix missiles. N0019-68-C-0240. $2,801,634 (contract modification). Incremental funding for Phoenix missiles. N00019-67-C-0240. $2,000,000 (contract modification). Incremental funding for Phoenix missiles.

NOw 68-0379. Naval Air Systems Command, Washington, D.C.

—Electronic Communications, Inc., St Petersburg, Fla $2,483,465 Airborne UHF telemetry transmitters. Naval Air Systems Command, Washington, D.C. N00019-69-C-0665.

—Sparton Corp., Jackson, Mich. $1,200,000. AN/SSQ-50 sonobuoys. Naval Air Systems Command, Washington, D C. N00019-69-C-0650.

—Sundstand Corp., Rockford, Ill. $1,775,274 (contract modification). Constant speed drive units for the Air Force Naval Air Systems Command, Washington, D.C. N00019-68-C-0083.

8—United Aircraft Corp., Stratford, Conn $18,087,682. HH-53C helicopters for the Air Force. N00019-69-C-0620 $9,575,156. CH-53C helicopters for the Air Force. N00019-69-C-0621. $2,431,533 (contract modification). HH-53 helicopters for the Air Force. N00019-68-C-0627. Stratford and Bridgeport, Conn. Naval Air Systems Command, Washington, D.C.

—Hughes Aircraft Co., Culver City, Calif. $7,500,000. Phoenix missile program. Tucson, Ariz., Culver City, Los Angeles, El Segundo, and Canoga Park, Calif. Naval Air Systems Command, Washington, D.C. N00019-69-C-0621.

—Raytheon Co., Inc., North Dighton, Mass. $2,225,930. Mark 72 Mod O signal data converters and associated equipment. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2323.

—Raytheon Co., Inc., Sudbury, Mass $3,-485,766 (contract modification). Poseidon guidance systems. Naval Strategic Systems Project Office, Washington, D.C. N00030-66-C-0159 PO11.

—General Electric Co., Washington, D.C. $3,878,751 (contract modification). Guidance systems for Poseidon missiles. Pittsfield, Mass. Naval Strategic Systems Project Office, Washington, D.C. N00030-66-C-0184 PO11.

—Singer General Precision Inc., Wayne, N.J. $9,000,000 (contract modification). Guidance systems for Poseidon missiles. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0086 PO06.

—Westinghouse Electric Corp., Baltimore, Md. $3,332,118. Increased funding for the complete integration of the Mark 27 Mod O sonar tracking system into production prototype targets. Naval Ordnance Systems Command, Washington, D.C. W-64-0705-i.

—Norfolk Shipbuilding and Drydock Co., Norfolk, Va. $1,827,200. Regular overhaul of the USS Fort Mandan (LSD 21). Supervisor of Shipbuilding, Conversion and Repair, Fifth Naval District.

—Horne Brothers, Inc., Newport News, Va. $1,678,765. Regular overhaul of the USS Chilton (LPA 38). Supervisor of Shipbuilding, Conversion and Repair, Fifth Naval District.

9—Massachusetts Institute of Technology, Cambridge, Mass. $3,000,000 (contract modification). Incremental funding for Poseidon advanced guidance systems. N00030-69-C-0089 PO03. $4,849,885 (contract modification). Poseidon guidance systems. N00030-66-C-0180 PO11. Naval Strategic Systems Project Office, Washington, D.C.

—Control Data Corp., Bethesda, Md. $3,-957,012. Engineering services for the Fleet Ballistic Missile Training System, and technical services for Poseidon and Polaris missiles. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0005.

—Sangamo Electric Co., Springfield, Ill. $3,190,433. Detecting ranging sonars, transducers, associated repair parts and data, and engineering services and support. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1468.

10—CGS Scientific Corp., Southampton, Pa. $1,307,750. Construction of a compression chamber at the Naval Submarine Medical Center, Groton, Conn. Naval Facilities Engineering Command, Washington, D.C. N62319-69-C-0021.

11—Lockheed Missile and Space Co., Sunnyvale, Calif. $102,313,868 (contract modification). Poseidon missiles and related equipment. Naval Strategic Systems Project Office, Washington, D.C. N00030-66-C-0186.

—Vitro Corp., Silver Spring, Md. $12,894,-991. Engineering services for fleet ballistic missile systems (Polaris and Poseidon). Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0010.

—Bendix Corp., Baltimore, Md. $1,211,379 (contract modification). Airborne receiver transmitter and associated equipment for the Air Force. Naval Air Systems Command, Washington, D C. NOw 66-0637

14—RCA, Moorestown, N J. $7,562,972. Manufacture of AN/TPQ-27 radar equipment. Naval Electronic Systems Command, Washington, D.C. N00039-69-C-3539

—Infrared Industries, Inc., Waltham, Mass. $1,322,986. Optics assemblies for proximity fuses for 5-inch 38 and 5-inch 54 caliber ammunition. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0372.

—Barnett Construction Co., Memphis, Tenn. $1,308,000. Construction of the first increment of an enlisted men and non-commissioned officer's club, Naval Air Station, Memphis, Tenn Naval Facilities Engineering Command, Washington, D C. N62467-67-C-0166.

—General Dynamics Corp., Groton, Conn. $5,823,500 (contract modification). Additional design agent services in support of the Fleet Ballistic overhaul program (USS Lafayette SSBN 616 class). Naval Ship Systems Command, Washington, D.C. NObs 38/A.

—North American Rockwell Corp., Anaheim, Calif. $3,441,000. Repair of Ships Inertial Navigation Systems gyroscope and velocity meters. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5012 PO01.

—General Dynamics Corp., Groton, Conn. $2,107,100. Engineering and planning yard services to support the alteration, maintenance, repair and overhaul of operational submarines. Naval Ship Systems Command, Washington, D.C. N00024-69-C-0239 PZ02.

—Sperry Rand Corp., Syosset, N.Y. $2,082,-000. Technical assistance program for Poseidon C-3 missile logistic support. Naval Ship Systems Command, Washington, D.C. N0024-70-C-5041.

15—Forsberg and Gregory, Inc., Redlands, Calif. $1,528,380. Construction of an aircraft maintenance hangar, Marine Corps Air Facility, Santa Ana, Calif Naval Facilities Engineering Command, Washington, D.C. N62473-68-C-0156.

—Jefferson Construction Co., Cambridge, Mass. $1,065,150. Construction of Waves Bachelor Officer Quarters, Naval Station, Newport, R. I. Naval Facilities Engineering Command, Washington, D.C. N62464-68-C-0108.

—Sperry Rand Corp., Syosset, N.Y. $10,-450,000. One year engineering service program for the Polaris/Poseidon system. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5008.

—General Dynamics Corp., Groton, Conn. $3,962,960. Design services in support of the Fleet Ballistic Missile submarine second overhaul program (USS George Washington SSBN 598 class). Naval Ship Systems Command, Washington, D.C. N00024-69-C-0235 PZ04.

16—Arnold M. Diamond, Inc., Great Neck, N.Y. $1,123,958. Land fill and site improvements, U.S. Naval Academy, Annapolis, Md. Naval Facilities Engineering Command, Washington, D.C. N62477-68-C-0829.

—VARO, Inc., Garland, Tex. $6,944,000. Mk 344 Mod O and Mk 376 Mod O electric bomb fuzes. Naval Air Systems Command, Washington, D.C. N00019-70-C-0057.

—North American Rockwell Corp., Columbus, Ohio. $2,361,697 (contract modification). Evaluate the feasibility of an improved target marking and light armament system for the OV-10A aircraft. Naval Air Systems Command, Washington, D.C. N00019-69-C-0445.

—Hazeltine Corp., Little Neck, N.Y. $1,040,-000 (contract modification). Electronic packages for AN/GSQ-141/142 receiving transmitting sets, less batteries, for the Army. Naval Air Systems Command, Washington, D.C. N00019-69-C-0617.

17—Lockheed Missile and Space Co., Sunnyvale, Calif. $28,136,478. Tactical engineering services for the Fleet Ballistic Missile Weapon System (Poseidon and Polaris). N00030-70-C-0020. $9,685,948. Polaris tactical field engineering services. N00030-70-C-0008. Naval Strategic Systems Project Office, Washington, D.C.

—North American Rockwell Corp., Anaheim, Calif. $4,084,000. Repair of Mk II Ships Inertial Navigation Systems components. N00024-70-C-5016 PO01. $1,239,-000. Engineering services for Ships Inertial Navigation Systems during Poseidon conversion of Fleet Ballistic Missile submarines. Newport News, Va., Groton, Conn , Vallejo, Calif , Portsmouth, N.H , and Bremerton, Wash N00024-70-C-5018 $1,128,924. Maridan Computers for Ship Inertial Navigation Systems components N00024-70-C-5047. Naval Ship Systems Command, Washington, D.C.

—Sperry Rand Corp., Long Island, N Y $1,913,929. Repair services of Fleet Ballistic Missile submarine navigation subsystem components. Syosset, N.Y. Naval Ship Systems Command, Washington, D.C N00024-70-C-5034.

18—Computer Sciences Corp., El Segundo, Calif $1,068,758. System analysis design, flow charting and programming support for Navy Data Systems and Operating Systems. Navy Electronic Laboratory Center, San Diego, Calif. Navy Purchasing Office, Los Angeles, Calif. N00123-70-C-0146

22—Seal and Co., Inc., Washington, D.C $1,948,000. Construction of a VLF antenna system, Naval Radio Station, Annapolis, Md Naval Facilities Engineering Command, Washington, D.C N25477-68-C-1098

—Republic Electronic Industries, Inc., Melville, N.Y. $2,241,351. AN/ARN-52(V) TACAN navigational sets. Naval Aviation Supply Office, Philadelphia, Pa. N00383-70-C-0408.

—Martin-Marietta Corp., Baltimore, Md. $1,578,925 (contract modification) Work on the Hart/Zap weapon system. Naval Ordnance Laboratory, White Oak, Md. N60921-68-C-0277 PO12.

—LTV Aerospace Corp., Dallas, Tex. $1,250,-000 (contract modification). Incremental funding for the flight demonstration program of a JP-5 fueled, air-launched ramjet propulsion system Naval Air Systems Command, Washington, D.C. N00019-68-C-0605

23—Arnold M. Diamond, Inc., Great Neck, N.Y. $2,212,248. Construction of a steam plant and electrical distribution systems, Public Works Center, Pensacola, Fla. Naval Facilities Engineering Command, Washington, D C. N62467-67-C-0544.

—Collins Radio Co., Dallas, Tex. $1,461,986 Engineering, furnishing, installing and testing a microwave wide-band, line-of-sight communications system. Naval Electronic Systems Command, Washington, D.C. N00039-70-C-0502

—Grumman Aerospace Corp., Bethpage, N.Y $1,200,000 (contract modification). Incremental funding for EA-6B aircraft Naval Air Systems Command, Washington, D C. N00019-67-C-0078

24—Sanders Associates, Inc., Nashua, N. H. $3,218,959 (contract modification). Airborne receiver transmitters and associated equipment. Naval Air Systems Command, Washington, D.C. N00019-68-C 0630

—Lear Seigler, Inc., Oklahoma City, Okla. $2,208,663. Services and materials for progressive aircraft rework on S-2 series aircraft. Brookley Industrial Air Park, Mobile, Ala. Naval Air Systems Command, Washington, D.C. N00019-70-C-0048.

—Simplex Wire and Cable Co., Portsmouth, N.H. $1,332,060. Manufacture of 21-Quad Multipair submarine cable Naval Electronic Systems Command, Washington, D.C. N00039-70-C-3504.

25—Newport News Shipbuilding and Dry Dock Co., Newport News, Va. $88,000,000 Construction of two nuclear-powered attack submarines (SSN 686 and 687) of the USS Sturgeon (SSN 637) class. Naval Ship Systems Command, Washington, D C. N00024-69-C-0307.

—Clevite Corp., Cleveland, Ohio. $3,000,000. Increased limitation of authorization for Mk 48 Mod 1 torpedoes. Naval Ordnance Systems Command, Washington, D C. N00017-69-C-1426.

—General Motors Corp., Indianapolis, Ind $2,661,000. Rotor assemblies for TF41 engines for A-7E aircraft. Naval Aviation Supply Office, Philadelphia, Pa. F34601-69-2021-GB01.

28—United Aircraft Corp., East Hartford, Conn. $5,800,000 (contract modification). Increase in limitation of authorization for design, development and testing of the TF30-P-412 aircraft engine. Naval Air Systems Command, Washington, D.C. N00019-69-C-0393.

29—Sperry Rand Corp., St. Paul, Minn. $9,-740,500. Computer systems with associated services and support. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1402.

—Stanwick Corp., Arlington, Va. $1,628,-

12. Computer programming services for
pe commanders, at various locations.
avy Purchasing Office, Washington, D.C.
00600-70-D-0151.
lanning Research Corp., Los Angeles,
alif. $1,407,855. Programming services in
ipport of type commanders, at various
ival activities. Navy Purchasing Office,
ashington, D.C. N00600-70-D-0151.
nited Aircraft Corp., East Hartford,
onn. $1,058,589. Spare parts for J-48
3/8A engines used on F9 aircraft.
aval Aviation Supply Office, Philadel-
ia, Pa. N00383-0-69000A-AG405.
eatrice Food Co., Honolulu, Hawaii.
,081,648. Supplies of dairy products for
et and shore stations. Naval Supply
enter, Pearl Harbor, Hawaii. N00604-
-D-0016.
agnavox Co., Fort Wayne, Ind. $1,000,-
0 (contract modification). Research and
velopment on an airborne processor and
splay system. Naval Air Systems Com-
and, Washington, D.C. N00019-69-C-0606.
oneywell, Inc., Minneapolis, Minn. $1,-
2,938 (contract modification). AN/APN-
1(V) altimeter sets and associated
uipment for the Navy and Air Force.
aval Air Systems Command, Washing-
n, D.C. N00019-69-C-0388.
ockheed Aircraft Corp., Marietta, Ga.
,555,577 (contract modification). Re-
arch and development on a classified
oject. Naval Air Systems Command,
ashington, D.C. N00019-69-C-0309.
anadian Commercial Corp., Ottawa,
anada. $2,799,290. AN/ASH-20(V) flight
corder-locator systems and special sup-
rt equipment. Carleton Place, Ontario,
anada. Naval Air Systems Command,
ashington, D.C. N00019-70-C-0047.
orth American Rockwell Corp., Anaheim,
alif. $1,584,380. Design, development,
brication, testing and evaluation of
ototype gyroscopes. Naval Ship Systems
ommand, Washington, D.C. N00024-70-C-
40.
ommunications and Systems Corp., Falls
aurch, Va. $1,249,846. Data processing
d analysis relating to Fleet Maintenance,
pport, overhaul, and readiness of a
andard navy maintenance and material
anagement system. Naval Ship Systems
ommand, Washington, D.C. N00024-69-
5220.
AP Instrument Corp., Westbury, N.Y.
,981,670. Mk 53 Mod O attack consoles.
aval Ordnance Systems Command, Wash-
gton, D.C. N00017-70-C-0401.
eneral Precision Inc., Binghamton, N.Y.
,500,000. Two units of RF-4E weapons
aining sets. Naval Training Device Cen-
r, Orlando, Fla. N61339-70-C-0009.

DEPARTMENT OF THE AIR FORCE

n American World Airways, Inc., New
ork, N.Y. $97,450,000. Services necessary
the operation of the Eastern Test Range,
evard County, Fla. Air Force Eastern
st Range, AFSC, Patrick AFB, Fla.
08606-68-C-0040.
o, Inc., Arnold Air Force Station,
nn. $48,960,000. Management, operation
d maintenance of the Arnold Engineer-
g Development Center, Arnold Air
rce Station, Tenn. Arnold Engineering
evelopment Center, AFSC, Arnold AFS,
nn. F40600-69-C-0001.
orth Electric Co., Galion, Ohio. $9,821,-
6. Procurement of 24 switching centers
r the 407L tactical communication sys-
m. Electronic Systems Division, AFSC,
G. Hanscom Field, Mass. F19628-67-C-
70.
eing Co., Seattle, Wash. $6,095,843. De-
gn, development, study and testing pro-
ams for WS-133A-M and WS-133B
inuteman missiles. Space and Missile
stems Organization, AFSC, Los Angeles,
alif. F04701-69-C-0153.
orthrop Corp., Hawthorne, Calif. $1,-
6,160. Production of long lead time for
F-5 aircraft. Aeronautical Systems Divi-
sion, AFSC, Wright-Patterson AFB, Ohio.
F33657-69-C-1289.

2—McDonnell Douglas Corp., Tulsa, Okla. $1,603,236. Rehabilitation of Air Force Plant #3. Aeronautical Systems Division, AFSC, Wright Patterson AFB, Ohio. AF33 (657)16416.

—General Electric Co., Syracuse, N.Y. $9,263,760. Operation, maintenance and logistic support of spacecraft sensor sights for FY 1970. Shemya AFS, Alaska, Diyarbakir, Turkey, and Syracuse. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04604-69-C-0941.

—RCA, Moorestown, N.J. $4,839,946. Depot level maintenance and supply support for instrumentation radar systems. Air Force Eastern Test Range, AFSC, Patrick AFB, Fla. F08606-69-C-0051.

—William V. Austin & Assoc., Ventura, Calif. $1,701,001. Base support services at Los Angeles AFS, El Segundo, Calif. 6592nd Support Group, Los Angeles AFS, Calif. F04693-69-C-0057.

—General Dynamics Corp., Fort Worth, Tex. $1,515,000. Operation, maintenance and improvemnt of the radar target scatter facility, Holloman AFB, N.M. Air Force Missile Development Center, AFSC, Holloman AFB, N.M. F29600-69-C-0016.

3—Vitro Corp. of America, Eglin AFB, Fla. $11,738,326. Maintenance and operation of armament development test center range facilities, Eglin AFB, Fla. Armament Development and Test Center, AFSC, Eglin AFB, Fla. F08635-70-C-0070.

—Hayes International Corp., Birmingham, Ala. $8,511,040. Inspect and repair as necessary KC-135 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-68-C-3607.

—Collins Radio Corp., Cedar Rapids, Iowa. $6,150,704. Spare parts for integrated dual flight director/rotation go-around systems. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-2462.

—Emerson Electric Co., St. Louis, Mo. $1,-840,824. General purpose automatic test system in support of various types of aircraft. San Antonio Air Materiel Area, AFLC, Kelley AFB, Tex. F41608-68-C-8961.

—General Supply Corp., Limestone, Maine. $1,485,020. Repair siding and foundations on housing units, Loring AFB, Maine. 42nd Bombardment Wing, Loring AFB, Maine. F17600-69-C-0136.

—Hazeltine Corp., Little Neck, N.Y. $5,-927,699. Production of command and control electronics equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-68-C-0539.

—LTV Electrosystems, Inc., Greenville, Tex. $1,645,000. Modification of C-130 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-68-C-0707.

—General Dynamics Corp., Fort Worth, Tex. $1,410,216. Aerospace ground equipment for F-111D aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. AF33(657)18403.

—Sperry Rand Corp., Great Neck, N.Y. $1,-410,280. Refurbishment and modification of transportable radio navigational sets, air conditioners, related shelters, engineering services and spare parts. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1362.

—Westinghouse Electric Corp., Pittsburgh, Pa. $2,317,775. Procurement of anti-intrusion alarm sets, spare parts, and aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0447.

7—Systems Development Corp., Santa Monica, Calif. $9,929,770. Computer program updating and development of a system training program. F04606-69-C-0522. $2,-845,568. Computer program updating and development of system training programs for major Air Force commands. F04606-69-C-1239. $1,666,000. Services in support of the Space Defense Center's computer program. F04606-69-C-1238. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif.

—General Dynamics Corp., Fort Worth, Tex. $3,228,084. Modification, inspection and repair as necessary of B-58 aircraft. James Connally Airport, Waco, Tex. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-70-C-0002.

8—Bendix Corp., Teterboro, N.J. $7,591,000. Modification of B-52 aircraft. Oklahoma Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-2685.

—Modulux, Inc., Newark, Calif. $4,226,119. Production of 63 modular relocatable units for use as school facilities. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-69-C-4486.

10—Lear Siegler, Inc., Oklahoma City, Okla. $2,048,000. Time and materials contract for aircraft maintenance services on F-4 aircraft at Yokota AB, Japan. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-4413-0001.

—Dynalectron Corp., Fort Worth, Tex. $1,-273,000. Time and materials contract for aircraft maintenance on F-4 aircraft at Alconbury RAF, England. Oklahoma Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-4416-0002.

11—Lockheed Aircraft Corp., Marietta, Ga. $1,924,287. Spare parts for the C-5 aircraft. San Antonio Air Materiel Area, AFLC, Detachment 31, Marietta, Ga. AF 33(657)15053.

14—Kollsman Instrument Corp. Elmhurst, N.Y. $1,994,960. Production of pressure-temperature test sets. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-69-D-0020.

16—Maney Aircraft Parts, Inc., Gardena, Calif. $1,721,860. Modification of F-100 aircraft. Brea, Los Alamitos, Gardena, and Santa Ana, Calif. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-70-C-0058.

17—Northrop Corp., Hawthorne, Calif. $2,715,-775. Modification kits for T-38A aircraft. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F04606-69-A-0218-QP01AA.

—Atkins and Merrill, Inc., Marlboro, Mass. $1,028,050. Modification kits applicable to RF-4 series aircraft. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-69-A-4361-0001.

18—General Motors Corp., Indianapolis, Ind. $12,236,260. Procurement of TF-41-A-2 turbofan aircraft engines. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-67-C-0163-P078.

—North American Rockwell, Anaheim, Calif. $5,000,000. Research and development of the post boost propulsion system for Minuteman III. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0040.

—Chicago Aerial Industries, Inc., Barrington, Ill. $1,960,389. Procurement and installation of aerial cameras in RF-4 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1282.

22—Rand Corp., Santa Monica, Calif. $10,-400,000. Increment to contract for aerospace studies and research. Air Force Office of Scientific Research, Washington, D.C. F44620-67-C-0045.

—Borg-Warner Corp., Van Nuys, Calif. $3,-186,321. Procurement of parts for B-52 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-4073.

24—Lockheed Aircraft Corp., Marietta, Ga. $10,000,018. Production and modification of C-141 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. AF33 (657) 14886.

—Honeywell, Inc., Lexington, Mass. $1,-600,000. Reconnaissance equipment, spare parts and aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1099.

25—Fairchild Hiller Corp., Germantown, Md. $3,000,000. Repair and modification of C-119 aircraft. St. Augistine, Fla. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-68-C-1633.

—The Ohio State University Research Foundation, Columbus, Ohio. $1,102,189. Academic services in support of the Air Force Institute of Technology schools of systems and logistics, and civil engineering. Air Force Institute of Technology, Wright-Patterson AFB, Ohio. F33608-70-C-0001.

—Continental Aviation and Engineering Corp., Neosho, Mo. $1,224,336. Repair of J-69 engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-69-D-2080.

—Honeywell, Inc., St. Petersburg, Fla. $40,180,841. Guidance and control systems for the Minuteman III missile system. Space and Missile Systems Organization, AFSC, Los Angeles, Calif.

28—Lockheed Aircraft Corp., Marietta, Ga. $7,845,835. Spare parts for C-5A aircraft. Detachment 31, Headquarters, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF33 (657)15053.

—Cessna Aircraft Co., Wichita, Kans. $7,-668,395. Production of A-37B aircraft, spare parts, and aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0831-PZ03.

—LTV Electrosystems, Inc., Dallas, Tex. $1,391,856. Airborne data processing equipment, spare parts and related test equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0844.

29—TRW Systems Group, Redondo Beach, Calif. $12,799,999. Non-development support for Minuteman weapon system. F04701-69-C-0180. $6,500,000. Development support for Minuteman weapon system F04701-69-C-0179. Norton AFB, Calif. Space and Missile Systems Organization, AFSC, Los Angeles, Calif.

—Curtis-Wright Corp., Woodridge, N.J. $2,349,379. Overhaul of J-57 series engines and components. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F41608-69-D-0006.

30—Control Data Corp., Minneapolis, Minn. $1,948,000. Procurement of engine test cell automatic process control equipment and data. La Jolla, Calif. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-70-C-5247.

—LTV Aerospace Corp., Dallas, Tex. $1,-192,188. Advanced missile post boost system study. Grand Prairie, Tex. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0870.

31—Federal Electric Corp., Paramus, N.J. $27,795,801. Operation and maintenance of the Air Force Western Test Range technical facilities. Vandenberg AFB, Calif. Air Force Western Test Range, AFSC, Vandenberg AFB, Calif. F04697-67-C-0001.

—General Electric Co., Philadelphia, Pa. $14,412,628. Research and development of the Mk 12 Re-entry System. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF 04(694)-916.

—Singer-General Precision, Inc., Little Falls, N.J. $2,300,000. Inertial instrument development of the Advance Ballistic Re-entry System. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0177.

ASPER Case Listing

(Continued from Page 32)

ernment property. Revisions to DD Form 1662 are included in the case and the subcommittee report is expected soon.

Financial Accounting for Government-Owned Facilities. To consider the contents of ASPR Appendices B-301 and C-301 relative to the requirement for the maintenance of financial records by contractors. The General Accounting Office has recommended that contractors be required to maintain such records. The case is presently being studied by a subcommittee.

Single Service Management of Industrial Facilities. To develop procedures which will provide that only one contract authorizing use of government facilities will be in effect at any one location. It is intended that contracts which authorize the acquisition or furnishing of government facilities will provide for the automatic transfer of those facilities to the "use" contract upon receipt of installation. The subcommittee report is under review.

Corporate Administrative Contracting Officer Program. To provide for the appointment of a single corporate administrative contracting officer (ACO) to act, in the case of multi-plant companies, on matters which have corporate-wide application. The corporate ACO will not act on matters having only local application. These matters will continue to be received by the plant ACO. Development of this case will be completed in the near future.

From The Speakers Rostrum

(Continued from Page 17)

ment. However, to do our job right, we need to know more about the quality of transportation.

As engineers, you would not think of building a bridge without standards describing the quality of materials to be used. Nor would you use these materials without testing them to ensure they meet prescribed standards. We do not now have such standards to describe the quality of transportation, nor tests to reproduce the environment. Accordingly, it is hoped that by joint action of the technical societies, the universities, and as individuals in your everyday work, you will continue and renew your interest and efforts to define transportation engineering and to establish transportation performance standards.

You are the engineers who have the talent to improve the quality of the nation's transportation service. We, in the Defense Department, are anxious to cooperate with you and stand ready to assist you in your efforts. We know, as few others can, how essential transportation is to the success of the mission of national defense.

Sir Winston Churchill knew and he defined it well when he said:

Victory is a beautiful rose, but transportation is the stem without which the flower cannot grow.

DSA Quality Assurance

(Continued from Page 10)

be given to human error. Safety precautions will be programmed so that an erroneous command by the operator will be invalidated or curtailed, and a warning buzzer or light will alert the operator to correct or issue a new command or instruction to the computer.

A project has been assigned to the Staff Instrumentation Engineer in the Quality Assurance Directorate to develop and/or determine the required standards, frequency, and calibration and measurement devices for automated processes. The scope of the project will encompass industry, other elements of DOD, National Bureau of Standards, and other agencies to assure establishment of realistic standards, techniques and frequencies of calibration. This action will result in modification of present calibration specification and various test methods and procedures.

Recognizing the emergence of automated production technology and the increased specialized skill requirements, the DCAS Quality Assurance Directorate has programmed internal and external training and education courses to ensure that quality assurance personnel understand and become part of the automated age. Present emphasis is on computer technology and advanced statistical concepts for progression in the employee's development program. In addition, personnel recruitment is slanted more and more toward professional personnel. The DCAS Quality Assurance Directorate is preparing to meet the challenge of automation and will be ready when tomorrow becomes today. As one of our leading industry's advertisment states, "Man thinks; machines work."

Blade De-Icers Aim of Army Chopper Program

Icing on vertical take-off and landing (VTOL) aircraft is getting a hard look from the Army. Combat Developments Command (CDC), Fort Belvoir, Va., has visions of lightweight, removable anti-icing/de-icing equipment for VTOLs, utilizing surface coatings, electrothermal, hot-air thermal, or fluid and mechanical devices.

Major problems caused by icing include severe vibration from uneven shedding of ice by the rotor blades, decreased visibility, and loss of lift and performance from airfoil distortion. Icing also lowers engine performance, and can cause damage when ingested by the engine.

Modern, high-powered helicopters suffer less performance losses under icing conditions than older, lower-powered models did, but still suffer from vibration damage. Until icing can be neutralized or prevented, the operational flexibility offered by modern engines, instrumentation, electronics and increased stability will never be fully realized.

Army Exploring New Laser Uses

Under the guidance of the Combat Developments Command (CDC), Fort Belvoir, Va., the Army is moving into the age of the laser. Presently under study at CDC are laser programs ranging from combat to support activities, for use now through the 1980s.

The laser generates an intense light through exitation of the atomic structure of its source substance. Different substances produce light of different wavelengths, with different capabilities and potentials.

A ruby laser has already been used as a range finder in tests with the M160A1E2 tank. In these tests, the ruby laser provided quick and accurate weapon to target distance figures, promising increased "first round kills" for future armor missions. CDC also sees possibilities in artillery, air defense and other firepower areas, where effectiveness depends on accuracy and speed.

Point-to-point communications also has applications, according to CDC. Improvements in lasers and fiber optics could permit a single channel to simultaneously carry 100 million telephone calls, coast to coast. Very highly "coherent" lasers could bring advances in communications security control, making it almost impossible for any enemy to jam or tap such a system. In a related area, some day lasers may be used to recharge tactical and strategic satellites in orbit.

With lasers, surveyors could determine topographic features accurate to the nearest centimeter, or even millimeter, instead of the nearest meter. Surveillance and target acquisition may see television-like images and displays, thanks to laser; and weed control may use the laser for clearing highways and waterways.

The laser has already been used for delicate eye surgery, and in the future it may be used for treatment of certain cancer types. The high heat levels of certain lasers may find application in sterilization, reducing the amount of equipment now required by medics in the field, and bringing instantaneous food treatment and preparation to realization.

Lasers operating in the invisible regions of the spectrum may provide new concepts in night operations and weaponry, while the cyanide laser, which operates in areas of the spectrum that pass easily through the atmosphere, may contribute to further exploitation of "paths of least resistance."

The uses of the laser seem limited only by human imagination ,according to CDC's Electronics Division. By the 1980s the laser may be as common as the helicopter is today.

New Earth Movers Goal of Army Engineers

The Army is out to get rid of dirt. In a recent Qualitative Materiel Development Objective, issued by the Army Combat Developments Command (CDC), Fort Belvoir, Va., CDC's Engineer Agency asked for the development of highspeed excavating equipment, materiel and techniques.

With an increased emphasis on mobility and dispersion, CDC foresees the development of radically new equipment. Present needs for rapid construction of roads, barriers, obstacles, artillery emplacements, and personnel, command and supply shelters are expected to increase. The Army also see such machines as an effective means of decontaminating areas of chemical-biological-radiological contamination.

CDC is seeking materiels and techniques that would increase productivity and reliability. The machinery would weigh less and be easier to maintain. It would be able to travel cross-country or in convoy, or be deliverable by aircraft or heavy-lift helicopters. The new equipment should also result in reductions of the number of items, and the weight of existing equipment, in the Army inventory, and in logistics, training requirements and operating personnel.

One of the new concepts in excavating machines is REDSOD—the Repetitive Explosive Device for Soil Disaggregation and Displacement. Attached to conventional equipment, such as the crawler tractor, REDSOD has a theoretical potential of up to 150,000 cubic yards per hour, compared to the 125-cubic-yards-per-hour limit of present machinery.

Relatively lightweight—at 25 tons —REDSOD uses controlled explosions to move earth. REDSOD consists of a dozer blade with multiple chambers. A mixture of compressed air and fuel is fed into the chambers and, when sufficient pressure has built up, a spark ignites the mixture. The expanding gases are directed out of slots at the base of the blade into the ground, blasting out the earth. Continuous ignition in the chambers results in continuous eruption of the earth. For use in both soil and soft rock, REDSOD would ideally, control the direction of excavated earth, placing it in rows 5 to 20 feet from the work site.

Free-Drop Food Containers Sought by Army

Free-drop containers may be used in the near future to deliver drinking water to troops in remote areas and, under guidelines specified by the Army Combat Developments Command (CDC), Fort Belvoir, Va., the weather-resistant, disposable containers could also be used for beverages or dry food.

Use of the containers would simplify present problems of supplying special action forces operating in areas with minimum support, where potable water and food supplies are difficult to obtain.

The free-drop containers would withstand impacts from helicopters or fixed-wing aircraft operating at altitudes between 50 and 250 feet, at speeds up to 130 knots. CDC also calls for the containers to have 3-gallon capacity, to be resealable after partial use, and to be reusable.

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AFLC Reorganization Plans Announced

The Air Force Logistics Command (AFLC) has announced a reorganization and consolidation of functions at its headquarters at Wright-Patterson AFB, Ohio, expected to become operational by October 15.

Following an extended planning study, General Jack G. Merrell, Commander, AFLC, announced the changes in a letter to AFLC staff components.

The letter called for the establishment of a Deputy Chief of Staff for Materiel Management, intended to centralize weapon systems and commodity management control functions presently associated with the the Deputy Chiefs of Staff for Operations, Supply, and Maintenance.

Brigadier General W. W. Snavely, major general nominee and present Deputy Chief of Staff for Plans, will head the new office. His assistant will be Brigadier General W. A. Jack, the current Assistant Deputy Chief of Staff for Supply.

Remaining functions of the Deputy Chief of Staff for Operations will be consolidated with the Deputy Chief of Staff for Plans designated as the Deputy Chief of Staff for Plans and Operations. The present Deputy Chief of Staff for Operations, Major General F. J. Ascani, will become Deputy Chief of Staff for Plans and Operations. His principal civilian assistant, W. W. Klare, will remain with General Ascani.

The functions of the Deputy Chief of Staff for Supply, including distribution, will be consolidated with those of transportation under a new Deputy Chief of Staff for Supply and Transportation to be headed by Colonel R. E. Carlson, present Deputy Chief of Staff for Transportation. His number one civilian assistant will

r Maintenance Engineering will be Staff for Maintenance, with responsibilities for staff surveillance of industrial operations and all production functions. Brigadier General R. E. Hails, now Assistant Deputy Chief of Maintenance Engineering, will assume the new position, with J. M. Myer as his top civilian aide.

Marines, Army Propose Mini-Transceiver

A 20-ounce single unit radio transceiver small enough to fit inside a soldier's fatigue vest pocket is under study by the Army and Marine Corps. A prototype of the radio has been developed by the Marine Corps, and the Army Combat Developments Command, (CDC), Fort Belvoir, Va., is monitoring results for the Army.

The proposed radio, AN/PRC–68, would provide two-way voice communication up to 500 meters without an external antenna system. With 1,000 channels available spaced 50 KHz apart, in the tactical frequency (FM) band, the radio would be compatible with standard military tactical field equipment. Channel selection would be predetermined.

The water and dust tight, air droppable unit is proposed for squad sized units, and the multichannels would allow many squads to operate in close proximity without interference or jamming.

The single-pack unit would replace the bulkier two-piece squad radio currently in use, increasing the unit commander's control over his forces.

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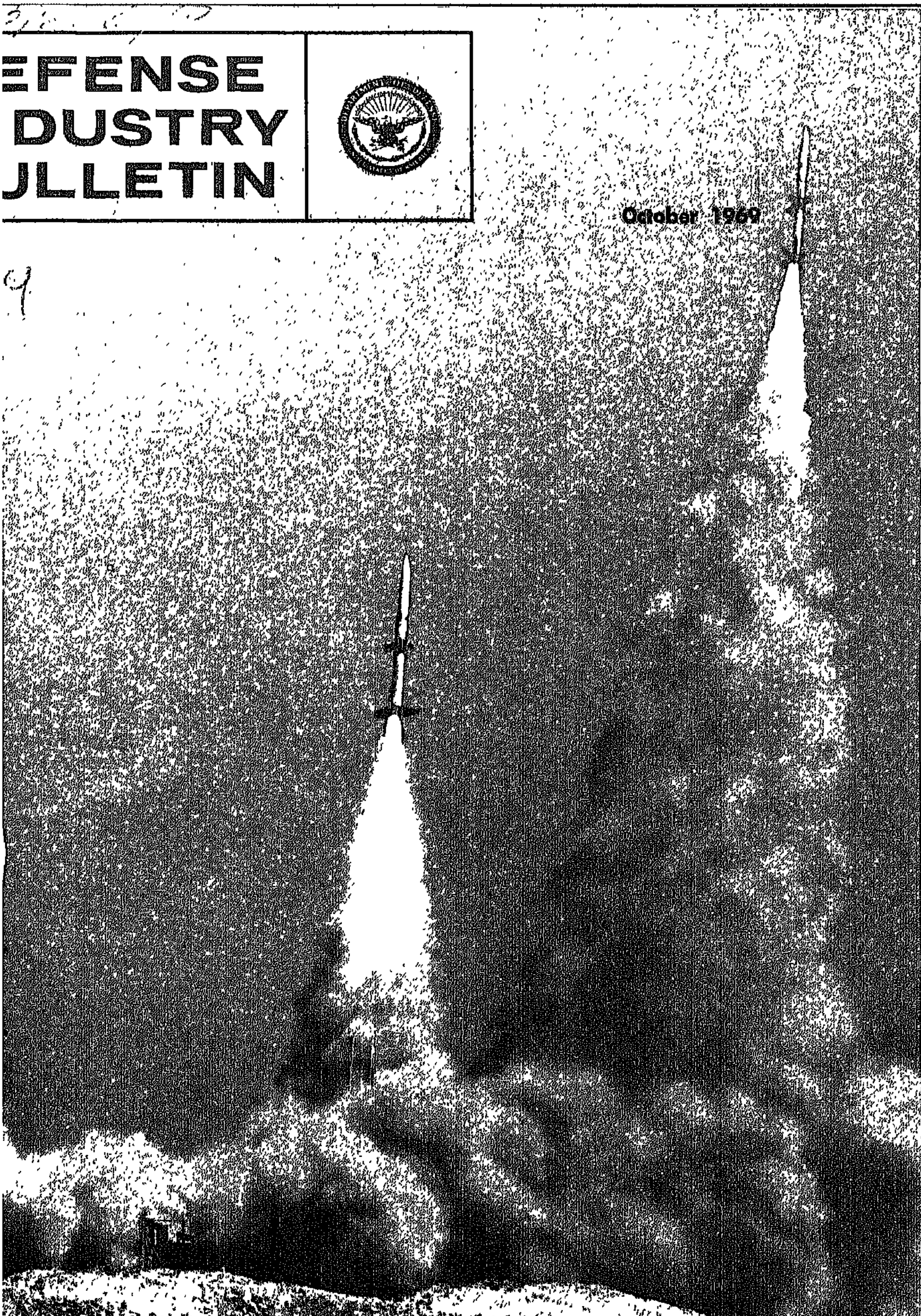

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Suggestions from industry representatives concerning possible topics for future issues are welcomed and should be forwarded to the Editor at the address shown below.

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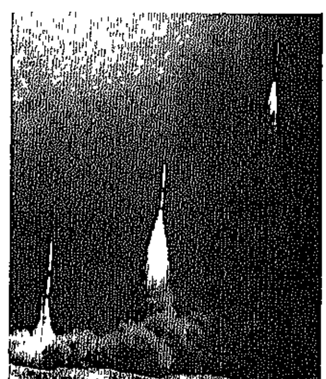
DEPARTMENTS

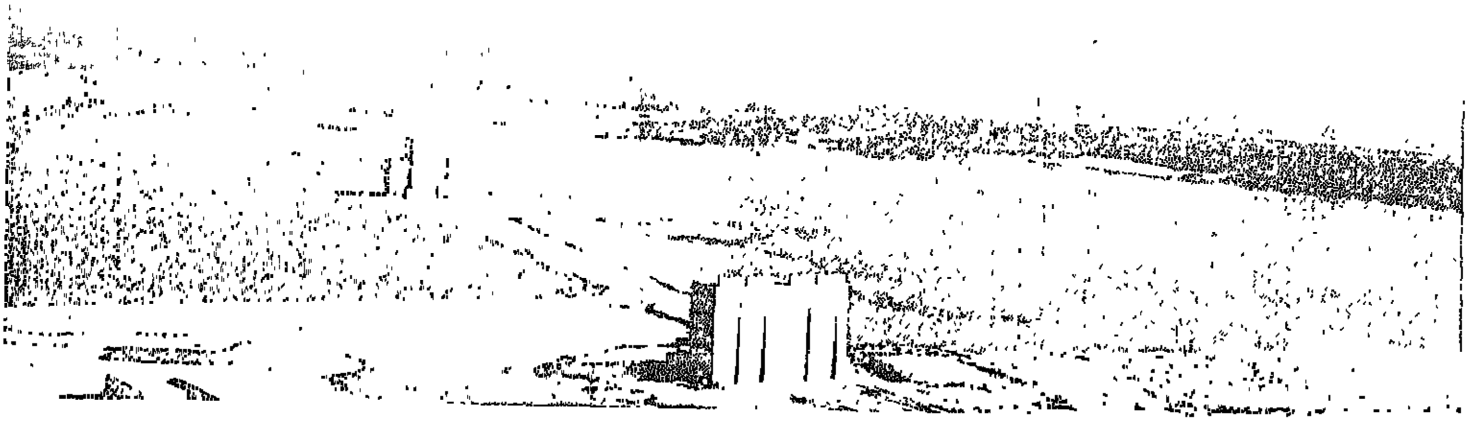


Shown on the cover are three stages in a successful launch of an Athena missile. The Athena program is just one facet of the multi-missioned Space and Missiles Systems Organization (SAMSO) of the Air Force Systems Command, whose story is featured in this issue.

Space and Missile Systems Organization

Working Partner with Industry

Lieutenant General John W. O'Neill, USAF



Few Air Force or Defense Department elements have as close and vital a working partnership with industry as the Air Force Systems Command's Space and Missile Systems Organization (SAMSO). SAMSO's beginnings date back to the now historic era of the mid-1950s, when the Air Force and industry were pooling brainpower, experience and energies in a top priority race to develop the first U.S. ballistic missile capability. The alliance has remained exceptionally strong and fruitful in the years since—through the birth of the space age and into today's new generations of missiles and of operational, as well as purely experimental, space systems.

As presently constituted, SAMSO was established on July 1, 1967, from elements of the former Space and Ballistic Systems Divisions of the Air Force Systems Command. It is the direct descendent of the original Western Development Division, set up in a Los Angeles schoolhouse in 1954 to begin the formidable task of developing and intercontinental ballistic missile (ICBM).

SAMSO is the management agency for planning, development, testing and acquisition of all Air Force space and ballistic missile systems. Headquarters of the organization is at Los Angeles Air Force Station. Missile elements are located at Norton AFB, San Bernardino; test wings at the Eastern and Western Test Ranges; missile site activation task forces at a number of bases in the northwestern and central United States; and space tracking facilities all over the world.

Our annual budget is more than $2.5 billion. We have a work force of approximately 7,000 people, military and civilian, worldwide. Our mission responsibilities include management of 19 major missile and space systems involving 53 major contractors; 1,100 other contractors; and hundreds of first- and second-tier subcontractors and suppliers in 28 states. We have estimated that something like 300,000 people in industry throughout the country contribute full-time efforts to SAMSO programs.

Strategic Missile Responsibilities

About half of the SAMSO budget is applied to strategic missile programs. The present U.S. deterrent missile force consists of 54 Titan ICBMs, 1,000 Minuteman missiles, and 656 submarine-based Polaris systems. These, with approximately 600 long-range bombers, constitute the nation's strategic power—our long-range retaliatory force.

We know that both the Soviets and Communist China are devoting exceptional efforts to development of their own nuclear strategic power. Secretary of Defense Laird has stated that the Soviet Union, with a gross national product of only one-half that of the United States, is spending $3 for every $2 spent by the United States on offensive strategic weapons. This year Russia will achieve the same number of intercontinental missiles in hardened silos as the United States now possesses. Secretary Laird has further stated that he believes the Red Chinese will have a long-range ICBM "in the next 18 months" (by mid-1970).

The goal of the SAMSO missile mission is to ensure that the U.S. missile force retains that edge over these known developments which spells deterrence, and the greatest measure of security which military strength can give us. We must continually develop and update our weapon systems in consonance with our national

strategy; with the abilities and intentions of potential enemies, as we understand these; and with the evolving state of the art as it offers new opportunities for improved weapon capabilities.

A Force Modification Program, to replace the Minuteman I systems already deployed in the field with the greatly improved Minuteman II system, is currently underway. This entails carefully time-phased modification of the ground sites for the first five of our six Minuteman wings. Wing VI was originally activated with Minuteman II systems. The program will be completed in the early 1970s.

At the same time development and testing of the Minuteman III is proceeding. Minuteman III is an advanced version, so greatly improved in its capabilities that it is as different from the original Minuteman I as the F-111 aircraft is from the P-51 of World War II fame. Among its major advances are greater power, improved guidance, and the capability for launch of multiple independent re-entry vehicles (MIRVs) upon a single missile.

The Minuteman is an example of the associate contractor approach to procurement and production, one successful innovation of the missile program. The Boeing Co. is the integrating contractor, handling assembly and test. TRW performs systems engineering and technical direction of the programs. Sylvania Electronics Systems is responsible for ground electronics for Minuteman III. Autonetics Division of North American Rockwell Corp. contributes guidance. Aerojet General, Thiokol and Hercules provide propulsion. AVCO and General Electric supply re-entry vehicles. It has proved to be an exceptionally able team in the development and production of this ballistic system, which has become the mainstay of our deterrent missile force.

In planning beyond the Minuteman III, SAMSO is studying the possibility of larger vehicles that will carry heavier payloads, and increased hardening of both missile and launch sites. Extensive studies and tests in a hard-rock silo development program, for instance, have investigated the feasibility of housing our missiles in silos cut into solid rock or constructed of special concrete harder than granite. Such basing could substantially improve the ability of our deterrent missile force to survive enemy attack. This and other advanced planning concepts are geared into work being done to advance the state of the art, and to provide building blocks for future missiles of improved capabilities and greater effectiveness.

Re-entry System Research

Another major effort on the missile side of the house is the advanced ballistic re-entry system (ABRES) program. One important characteristic of ballistic missiles is the fact that great improvements in mission effectiveness can be obtained by improving the re-entry system alone, the business end of the missile—much as one might put a new and better nib on a pen. Therefore, research and development effort in re-entry systems promises proportionately high returns for the investment.

The Air Force is the executive agent for the development of all re-entry vehicles for the Defense Department, and the Army and Navy work with SAMSO in the endeavor. Over $100 million a year is spent to study and test designs and techniques that will get our re-entry systems safely past both the natural hazards which they must survive on re-entering the atmosphere, and the enemy's defenses aimed at intercepting and destroying them before they can reach their targets.

A four-stage, subscale test missile, the Athena, has been developed for relatively low-cost testing of advanced re-entry system designs and concepts. Payloads are launched from Green River, Utah, over a 470-mile inland test range to impact within the Army's heavily instrumented White Sands Missile Range in New Mexico. Full-scale re-entry system tests are also made, using Atlas boosters, over the Western Test Range out of Vandenberg AFB, Calif., to the Kwajalein Atoll area of the Pacific.

The progress made in re-entry systems technology—one of the critical unknowns at the beginning of the missile programs—ranks among the most heartening proofs of the research and development capabilities of American industry.

Space Programs

Missile programs are, of course, only a part of the total SAMSO mission. The other half of our budget and our energies is devoted to work in military space systems. In 1961, the Air Force became the executive agent of the Defense Department for the development of a military space capability. The bulk of this responsibility rests with SAMSO.

Our efforts have been concentrated on three specific approaches:

- Development of a varied stable of space launch vehicles.
- Creation of a worldwide satellite control facility for tracking, servicing, commanding, controlling and recovering space systems.
- Development and launch of a number of space satellite systems, designed to probe the possibilities of accomplishing a variety of missions in space—nuclear detonation detection, communications, navigation, and others.

Stable of Boosters. The boosters are varied and extremely flexible in their potential. Most of them are adaptations of ballistic missiles originally designed as weapon systems—the Thor, Atlas, Titan and Minuteman. They can place in near-earth orbit (100-mile altitude) spacecraft varying in weight from 300 pounds to as

Lieutenant General John W. O'Neill, USAF, became Vice Commander of the Air Force Systems Command on Sept. 1, 1969. At the time this article was written, he was Commander of the AFSC Space and Missile Organization, and prior to that commanded the Electronic Systems Division of AFSC. General O'Neill earned a bachelors degree from Boston University, a masters degree from the University of Pittsburgh, and is a graduate of the Air War College.

much as 25,000 pounds. They can put payloads weighing up to 2,000 pounds into synchronous orbit (22,000 miles altitude). The Titan IIIC, latest and most powerful of the boosters to join the inventory, has an upper-stage restart capability and has put as many as eight separate payloads into individual orbits in a single launch.

The record of reliability of our launch systems has improved steadily. For the last five years, the launch success score has been over 90 percent.

Satellite Control Facility. In the second major approach to space system responsibilities, SAMSO has developed a space tracking control and recovery network, designated the Air Force Satellite Control Facility. Its worldwide network is operational around the clock receiving data from our spacecraft, issuing instructions to them, checking regularly on their operational health, and de-orbiting and recovering them as required.

The Satellite Control Facility, with its main control center at Sunnyvale, Calif., currently services between 40 and 50 space systems daily. Its workload has risen rapidly over the past five years, as increasing numbers of long-life satellites have been put into orbit.

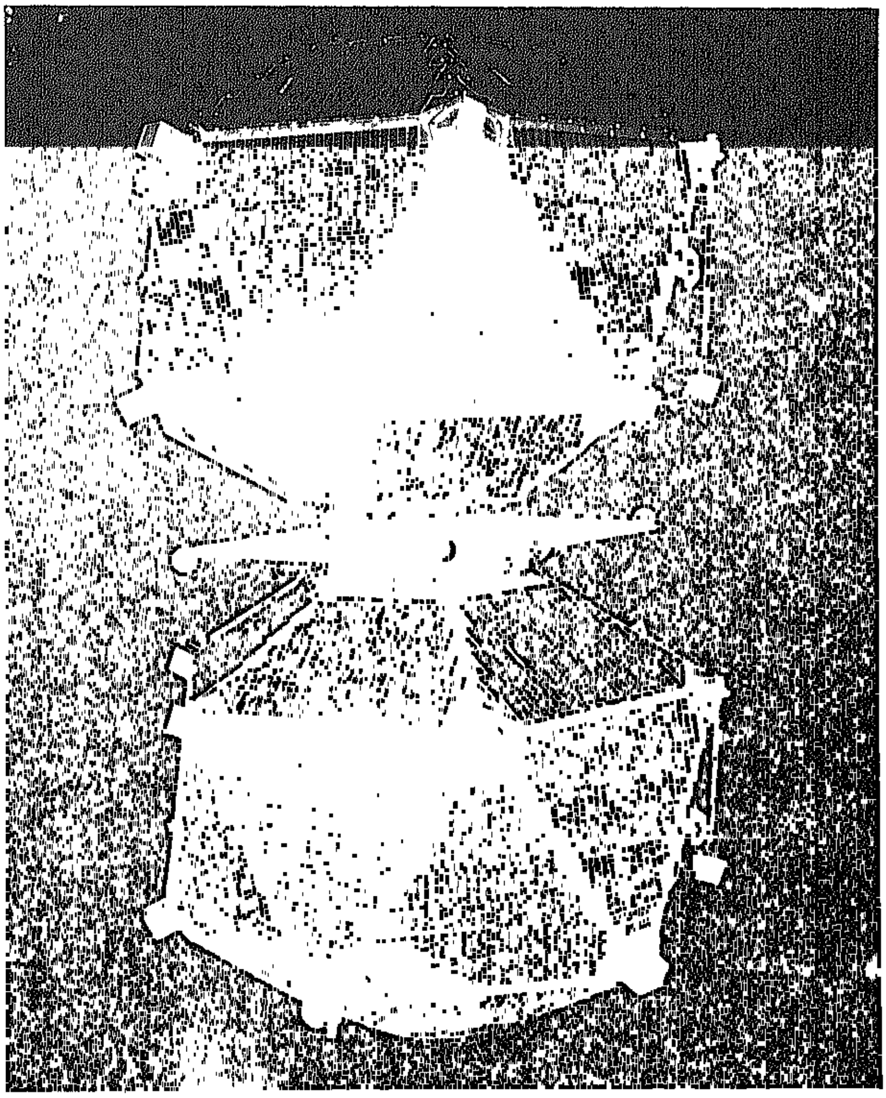
Spacecraft. In the third area of major space program activity, a wide variety of satellites have been developed and launched for certain types of military missions which can be most advantageously performed in the space environment.

The oldest of these satellites still in orbit is the VELA nuclear detonation detection satellite, developed to monitor the Nuclear Test Ban Treaty. The first pair of VELAs was launched in 1963; 10 have now been put into orbit. The last pair of VELAs was launched July 23, 1969.

Octahedron-shaped systems, the latest models of which weigh about 735 pounds, the VELAs operate in random orbit at a altitude of 60,000 nautical miles, circling the Earth every 108 hours. They can detect nuclear events both on the surface of the Earth and far out into deep space. In addition to successfully performing their primary nuclear detection mission, the VELAs have provided from their lofty orbit valuable information on the solar wind characteristics and a variety of other scientific data, including surveys of radiation for the manned space flights.

The VELAs, produced by TRW Systems, were trail blazers in incentive contracting of space systems and continue to be one of the most noteworthy examples of the benefits which can accrue to both Government and industry from incentive procurement. Originally designed for a life expectancy of six months and launched in 1963, the first two VELAs are still functional. TRW has earned all of the incentive profits in the contract package. Because of the endurance and reliability of the earlier systems, the Air Force has been able to stretch out the time interval between subsequent launches and, thus, accomplish very substantial state-of-the-art improvements from one pair of VELAs to the next.

Another of our satellite programs—and one of our most prolific—is the Initial Defense Communications Satellite System (IDCSS) effort. These systems provide global strategic communications, excepting only the areas of the North and South Poles. They are under the direction and control of the Defense Communications Agency. Twenty-seven of the spacecraft have been placed in a near-synchronous equatorial orbit in a series of multiple launches by the Titan IIIC. Getting the satellites into their individual orbits was one of the most sophisticated space maneuvers attempted to date. Twenty-four of the systems are now functional and giving excellent service, chiefly between the United States and Southeast Asia. The systems are programmed to turn them-



Still alive, and sending signals since 1963 from 60,000 nautical miles out in space, the VELA nuclear detonation detection satellites monitor the Nuclear Test Ban Treaty. Launched in pairs, there are now 10 VELA satellites in near-circular orbit.

SPACE AND MISSILE SYSTEMS ORGANIZATION

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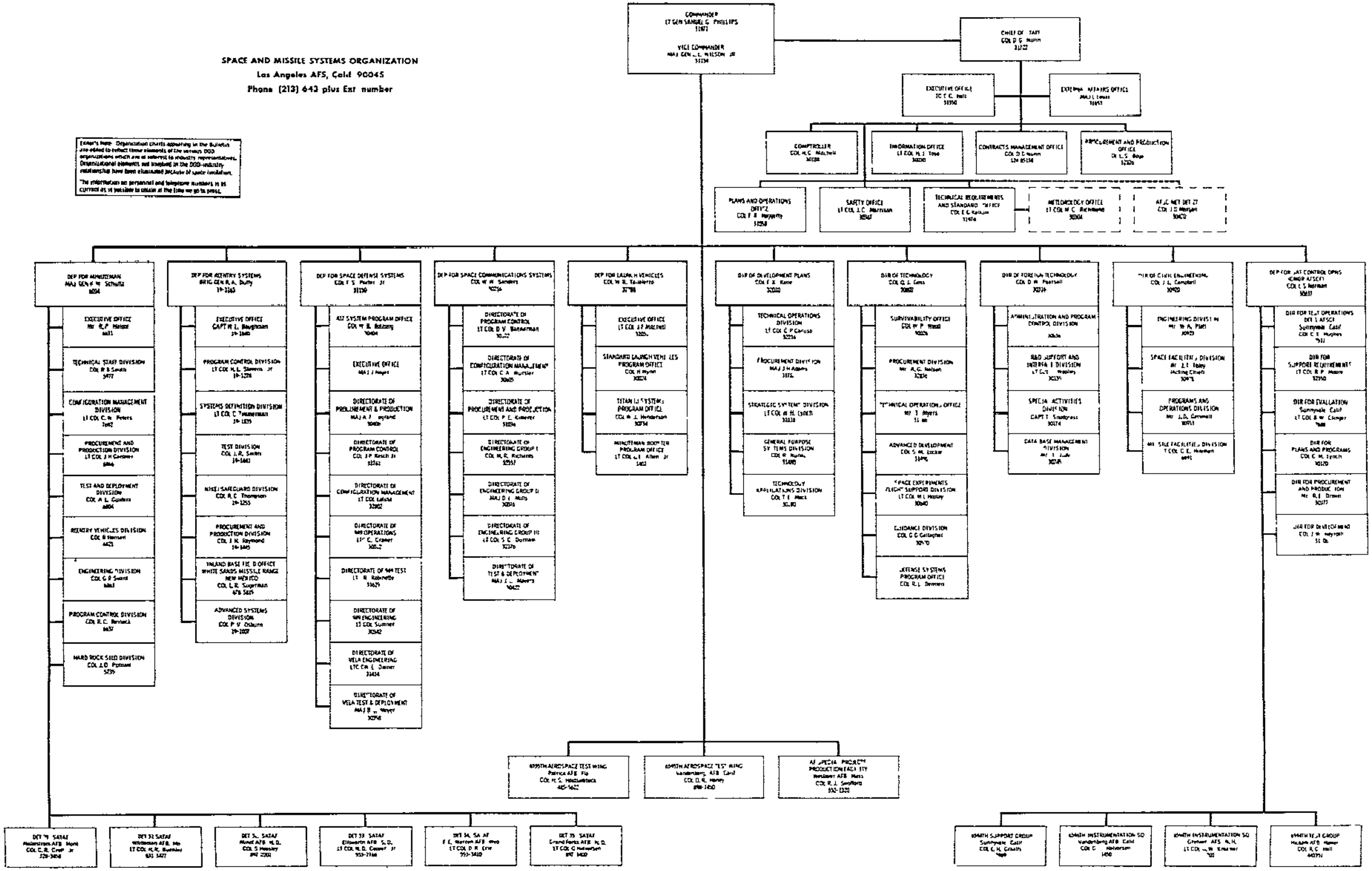
Phone (213) 643 plus Ext number



selves off at the end of six years, by which time we plan to have orbited a greatly improved system with much more power and enormously increased capabilities.

In the meantime, development is proceeding on two communication systems very similar to the IDCSS, but with more specialized area coverage. One is being developed for the United Kingdom and the other for NATO. They will be launched by the end of this year.

Still another SAMSO program, designed to tap in on the natural advantages which space offers for communications, is the Tactical Communications Satellite (TACSAT I). This is a tri-Service experimental program which enables establishment of always critically needed communications in the field between users having very small receivers—in airplanes, tanks, jeeps, ships and even in the backpack of the foot soldier. This is made possible by concentrating a very large amount of power in the spacecraft itself to compensate for the low power of the small ground stations.

The first TACSAT I to date, developed and produced by Hughes Aircraft Co., was successfully launched into synchronous orbit (22,300 miles) by Titan IIIC on Feb. 9, 1969. Two stories tall, weighing about 1,600 pounds, it is the largest communications satellite yet orbited by the Free World.

We believe that this satellite foreshadows major improvements in tactical communications. It can be placed in space in a stationary position to provide coverage over specific areas of interest. To tactical action in such areas, this satellite can bring a communications capacity about equivalent to that of 10,000 two-way telephone channels. It can be moved from one point to another, and is designed for a service lifetime of about five years.

Shown, in artist's concept, resting in their metal container atop the transtage moments after the metal nose fairing has fallen away from the Titan IIIC space booster, are eight Initial Defense Communications System satellites (IDCSS) boosted into orbit. There are now 24 functioning IDCSS satellites spaced around the Earth, providing the first U. S. military communication system in space.

Advanced Planning

Another major mission responsibility of SAMSO is advanced planning for future space and missile developments. We conduct exhaustive studies, analyses and comparative assessments of feasible future missile and space systems, examined in the light of the evolving state of the art, knowledge of the capabilities or intentions of potential enemies, and changes in our own strategy or mission requirements. Alternatives, with all supporting data, are presented through channels to the top decision makers, military and civilian. Based on this information, they choose the programs to be funded and carried forward.

Many of these projects are classified. Typical of those which can be mentioned briefly here are studies on the next generation ICBM, on further hardening of Minuteman missile silos, on penetration aids for advanced re-entry systems, and on options for defenses against ballistic missiles.

Since launch costs are the major expenditure, and a limiting factor in space operations, a number of investigations of possible economies in this area are underway at SAMSO. Among these are studies on reusable boosters and on a minimum cost design launch vehicle called Big Dumb Booster (BDB). BDB features extremely simple design and relatively low-cost materials, as opposed to the more sophisticated subsystems and costly, lightweight alloys that have become traditional in space boosters.

Space systems and equipments presently under consideration include a navigation satellite system which could be used by aircraft, ships, submarines and land forces; a multi-purpose reusable spacecraft, manned or unmanned, which could be launched like a space vehicle, and upon re-entry into the atmosphere could be maneu-

(*Continued on page 28*)

DOD Announces Additional FY 1970 Expenditure Cut

On August 21, Secretary of Defense Melvin R. Laird announced preparations for cuts of up to $3 billion in FY 1970 defense expenditures. The cutbacks, he said, were required by Congressional limitations placed on Federal expenditures for the fiscal year ending June 30, 1970, anticipated budget cuts by Congress, and the economic needs of the country.

"Our problem is compounded by the fact that it now appears likely that the Defense Department budget will not be voted by the Congress before late this year—roughly halfway into FY 1970 . . .," Laird said.

The reductions announced were in addition to the $1.1 billion expenditure and $3.1 billion appropriations uts reflected in the revised FY 1970 udget. The new reductions will educe FY 1970 expenditures by more ian $1.5 billion. As these reductions re taken, the funds will be reserved, ending final Congressional action.

The cuts, as outlined by Secretary Laird, include the previously announced reductions in the Cheyenne and Manned Orbiting Laboratory programs, as well as the announced initial redeployments of troops from South Vietnam.

"We will be required, in order to make these savings, to lay up ships, reduce flying hours, close some bases, and reduce military and civilian manpower," the Defense Secretary said.

The proposed actions, by Service, are:

- The Army will reduce its FY 1970 non-Southeast Asia operations, maintenance and training by approximately $500 million. The Army, as part of this program, previously had announced plans to inactivate the 9th Infantry Division.
- The Navy will inactivate more than 100 ships.
- The Air Force will reduce its non-Southeast Asia training by 300,000 flying hours for the remainder of this fiscal year.

Total reductions in manpower were announced at 100,000 military and 50,000 civilian personnel, to be achieved by the end of the fiscal year. The decision on which bases would be closed has not been made; announcement will be made at a later date.

The Secretary emphasized the effect the cuts would have on the U.S. military's defense posture: "In summary, we are going to make the cuts in military spending. We will strive to alleviate to the maximum extent possible the adverse impact of these reductions. But it is clear that our defense readiness will be weakened."

On August 22, in a subsequent statement, Secretary of the Navy John J. Chafee announced details on the Navy's actions in compliance with Secretary Laird's budget reductions.

Of the more than 100 ships to be ultimately retired, 76 were identifie by Secretary Chafee. The majo ships included 50 combatants; amon these are the battleship USS Nev Jersey, the heavy cruiser USS Canberra, the antisubmarine aircraft carriers USS Bennington and USS Kearsarge, and the amphibious assaul ships USS Boxer, USS Princeton an USS Valley Forge. The balance of th list included destroyers and frigates submarines, additional amphibiou warfare ships, auxiliaries, and th mine countermeasure ship US Ozark.

The average age of the ships listec is 24.6 years, and 52 are more than 2 years old. The ships will either be decommissioned and placed in mothballs will replace older ships for naval reserve use, or will be scrapped. Retirement actions on the ships listed wer expected within three months. Othe ship reductions will be announced a details are worked out.

As a result of the reduction in ships, the manpower of the Navy will ultimately be reduced by about 72,000. Further savings are expected from reductions in civilian personnel, and in reductions at shore installations.

The loss of the ships is expected to be offset to a partial degree by new ships under construction and fleet modernization conversions, according to Secretary Chafee.

Air-Ground Casualty Recovery Aim of Army

A new high-speed, air-ground ickup system for evacuating injured ersonnel from hostile or inaccessible reas is being tested by the Army. The system is designed to "snatch" asualties from isolated areas with ninimum possible risk for the resuing aircraft.

Para-delivered to the recovery area, the system consists of a container into which the casualty is placed, and a tethered helium balloon. Pickup is made by an aircraft engaging the tether with a nose-mounted skyhook anchor system. The container, with casualty, is then pulled into the air and retrieved into the aircraft.

The Army Combat Developments Command, Fort Belvoir, Va., has specified that the container be aerodynamically "flyable" to prevent tumbling while being towed by the aircraft. Additionally, it must be capable of safely transferring ambulatory patients requiring extensive medical care, and be buoyant.

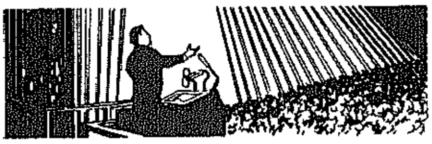
The system would prove valuable, according to the Army, in counterinsurgency situations, where heliports or similar areas would be impractical to build, or where conventional medical evacuation would be impossible.

USAF 666A Office Moved

The Air Force Avionics Laboratory's 666A Advanced Development Program Office has been relocated from Holloman AFB, N.M., to laboratory headquarters, Wright-Patterson AFB, Ohio.

The office is responsible for the development and flight testing of advanced aircraft navigation systems. Current efforts include precise inertial systems, such as the gimbaled electrostatic aircraft navigator, and integrated systems employing Doppler inertial and LORAN sensors.

Program manager is Major John H. Dean.



FROM THE SPEAKERS ROSTRUM

The Defense Budget and American National Security

Hon. Melvin R. Laird
Secretary of Defense

Excerpt from address by Hon. Melvin R. Laird, Secretary of Defense, before the National Convention of the American Legion, Atlanta, Ga., Aug. 26, 1969.

As your keynoter this afternoon, I want to talk to you about national defense and, in particular, about the hard choices we face in the defense budget. We in the Defense Department recognize that the American economy, bountiful though it is, is not a bottomless well. There are limits to what it can produce. We recognize, too, that, important as it is to provide for the security of the nation from external dangers, there are other urgent tasks before the nation for which additional resources must be allocated in both the public and private sectors of our economy.

That economy must continue to grow so as to make available more consumer goods and an expansion of plants and equipment. Our cities must be made more livable. Schools must be improved. Crime must be reduced. The poor must be provided for and, in all possible cases, equipped to provide for themselves. Pollution of air and water must be curbed. Transportation must be modernized. Health facilities and personnel must be expanded.

The list is long and growing. Progress toward these goals requires capital, labor, time—and the attention and energies of all of us.

Since there are limits to our resources, we as a people have to make choices. In particular, the President and the Congress have to make basic and difficult decisions about how many of a limited number of dollars will be devoted to each of the aims of the national Government, and how many will be left for state and local governments and the private sector to spend as they choose.

I can assure you that the Defense Department is deeply conscious of the taxpayer's burden and of the importance of the domestic needs that lead to claims for more federal spending for non-defense purposes. We are determined to keep defense spending down and to reduce it wherever possible, as long as we can do so without imprudently weakening our ability to meet our defense needs.

Most of the critics of military spending, of course, do not want to weaken our defense posture. Most critics feel that the defense budget is oversized and wasteful—a judgment they make principally because the Defense Department spends so large a part of our national government's budget. Our defense budgets, in absolute amounts, are large—but so are our responsibilities. Defense receives about 41 cents of every dollar disbursed from Washington, and the share allocated to defense has been shrinking. Defense expenditures in 1969 were less than 9 percent of our Gross National Product. Next year they will be lower, both in absolute amounts and as a percentage of the output of the economy.

We in the Defense Department share the objectives of our critics—we, too, want to achieve greater efficiency; we, too, are striving for a reduced level of defense spending.

Let me go a step further. We agree with our critics not only on objectives but also on the fact that there is room for additional substantial savings within the defense budget. The nub of the problem, however, is this: How best can we increase the efficiency of the Defense Department and operate with the lowest feasible defense budget without impairing national security in the process?

If our primary objective is to reduce the level of defense spending no matter what the consequences then, obviously, further substantial spending cuts could be effected immediately. But that course would be irresponsible.

We cannot take imprudent risks that the American people will not have the protection they need when they need it. As Legionnaires, you know as well as any citizens in this country the vital need for maintaining a strong defense posture. Those of you who have known the ravages of war understand better than anyone else the importance of preventing war. That has been my overriding concern and my number one priority since assuming the office of Secretary of Defense.

Reappraising the Defense Posture

So what we have to do in reappraising and adjusting our defense budget is to insure that any adjustments we make for the purpose of saving money or eliminating waste do not at the same time cut into the muscle of our needed preparedness and capability.

Let us not be blind to the unpleasant facts of life in the world about us. We are still engaged in a war. And, although I hope that we can continue steadily to reduce the number of American troops in Vietnam, there are more than 500,000 of our men there today. I will resist any budget cuts that could add to American casualties in Vietnam.

Let us not be blind to threats to

peace in Korea or in other trouble spots in the world where American military forces maintain a vigil.

Let us not be blind to other potential dangers to our country that may be magnified and intensified if we fail to maintain military strength at a realistic level.

We shall strive to make the years ahead an era of negotiation rather than confrontation with the Soviet Union. We shall try to reduce the danger of armed conflict by adequately safeguarded agreements on arms limitation.

Until such agreements are concluded, however, it would be folly to disarm unilaterally or to permit a general weakening of our military strength. And, in determining the level of military strength appropriate for the United States, we cannot ignore what is going on in the Soviet Union.

Since in the last analysis the American people will determine the size and the shape of our defense forces, I think it important that the people know the facts required to make an informed decision.

It is important that they know that the Soviet Union right now is devoting greater effort than the United States to strategic offensive and defensive forces.

On a dollar basis in 1968, the Soviet Union spent approximately two dollars for every one dollar expended by the United States on strategic offensive and defensive forces.

Since 1965, when the United States began a substantial increase in military spending to support combat forces in Vietnam, Soviet expenditures have risen rapidly for a different purpose—the strengthening of strategic forces. In 1968, Soviet spending for strategic forces was about 30 percent higher than it was n 1965, whereas U.S. spending for .uch forces has remained relatively stable.

I do not want the import of these 'acts to be misunderstood. Our overall nilitary capability today, together with the effort we have programmed n our defense planning, provides sufficient protection to the nation for the immediate future. But, if we project the trends which I have pointed out on beyond the next few years, doubts about our future security arise.

FY 1970 Budget Revision

In April, the Nixon Administration sent to the Congress a revised budget that was $3.1 billion lower than the Johnson Administration request in appropriations and $1.1 billion lower in actual spending.

That in itself was a difficult amount to squeeze out of the defense budget—not because the whole budget consists of muscle, but because getting the fat out without weakening the muscle is a function of such things as time and organizational change whose impact cannot be fully felt in the year in which it is undertaken.

The Chairman of the House Appropriations Committee has stated publicly that his committee will cut at least $5 billion from the appropriations request now pending before Congress. He alerted me to the fact that the current fiscal year is running and that action should be taken now to cut back defense programs.

In response to Congressional pressure, I announced last week that the Defense Department is preparing to cut spending this year by an additional $3 billion. Even these cuts do not satisfy some critics who impatiently demand additional major reductions in the level of spending this fiscal year.

These critics are urging a very dangerous course. If we are forced by Congressional action to make such additional cuts, the end result would be counterproductive. Rather than achieving real and lasting savings, we could instead be producing greater inefficiency, higher long-term costs, and greater problems than already exist in such intangibles as morale and personnel efficiency. We could, in short, reduce our defense readiness both for the short term and the long term, while bringing about only short-lived dollar savings.

Let me outline briefly for you precisely what the problem is. The budget proposed to the Congress in January 1969, by the Johnson Administration, called for $79 billion in defense spending.

The budget with which the Nixon Administration started was, in the eyes of the Services and the Joint Chiefs of Staff, an austere budget, since their initial requests totalled more than $100 billion. Now let me divide this reduced amount of $79 billion into several categories, to give you a better idea of the problems we face.

First of all, about $25 billion of that $79 billion represents the special cost of supporting our combat operations in Southeast Asia. This can be reduced only as a result of national policy decisions which reduce the level of our effort, such as the 25,000 troop redeployment announced by the President at Midway.

A little less than $3 billion represents payments to retired military personnel, fixed by law.

Southeast Asia costs and retired pay add to nearly $28 billion—well over one-third of our spending total.

This leaves $51 billion of that Johnson budget. About $8 billion is for strategic forces—for intercontinental ballistic missiles, Polaris submarines, bombers, and defense systems which are the backbone of our nuclear deterrent. Even if we adopted the posture advocated by the severest critics of defense programs, we would not make a major dent in that $8 billion for the current fiscal year. The recent antiballistic missile (ABM) debate, for example, did not significantly involve 1970 spending.

Another $6 billion is for research and development, aside from strategic forces and special Southeast Asia items. This is the part of our effort that provides our military strength for the future. Without adequate research and development, the American military in the future will find itself outmaneuvered, outgunned and overmatched. The Soviets are certainly aware of the critical importance of research and development. I recognize that this part of our program is a tempting target for budget cutters. It is an area where cuts can be made today without an immediate and apparent degradation of our forces. But, for the long run, nothing could be more detrimental than to neglect our research and development needs.

To complete the total, there are two remaining categories of defense spending. Our general purpose forces—aside from Southeast Asia—accounted for $22 billion of that Johnson budget total. This covers our Army and Marine divisions; our Naval forces—attack carriers, antisubmarine warfare forces, amphibious forces, and others; and Air Force tactical aircraft. Also included here are

our worldwide intelligence and communications systems; airlift and sealift; and our National Guard and Reserve forces. This $22 billion, in short, covers all the muscle we have, aside from the forces in Southeast Asia and the strategic forces that provide our nuclear deterrent.

Finally, the Johnson budget included about $15 billion for administration and support. This category covers our large training establishment; medical and hospital facilities; supply systems; the maintenance and rebuilding of weapons; and the general overhead of the Defense Department. These activities, of course, are essential to the success of all the programs of the department.

It is in the last two categories of the budget—our general purpose forces outside Southeast Asia, and the area of administration and support—that we must look for budgetary cutbacks. These two categories came to $37 billion in spending in the Johnson budget. We are now making preparations to cut $4.1 billion from the spending level in the Johnson budget, and most of this cut will have to come from these areas.

Now, let me introduce one further thought. We have been talking about *spending*—and about one-third of what we *spend* this year results from contracts in prior years. It is the payment now coming due on bills contracted in the past by earlier Administrations.

This, in a nutshell, is our problem: The programs that we can regard as serious candidates for immediate spending cutbacks comprise well under half of our budget—and even for these, a third of the spending is fixed by prior-year contracts. Thus, the planned spending cutbacks we have announced amount to 15 to 20 percent or more of the expenditures that are really subject to reduction at this time.

New Budget Cutbacks

[On August 21] I announced some of the actions we feel constrained to take as a result of the cuts Congress is expected to make in the Defense Department budget this year.

In order to make short-term savings, savings that would have a dollar impact in FY 1970, we have to lay up more than 100 ships, reduce flying operations by 300,000 hours, close some bases, and reduce military and civilian manpower probably by more than 150,000 before the fiscal year ends 10 months from now.

The actions announced last week, taken together with other cuts made earlier in the year, would reduce defense spending by $4.1 billion in FY 1970.

When I announced our preparations to make reductions of this magnitude, I said that they will inevitably result in some weakening of our worldwide military posture.

I apologize for overwhelming you with numbers, but it is impossible to discuss the budget without getting into figures. Let me summarize the conclusions to which all these statistics lead:

- Because of the clear intention of of Congress to force a heavy cut in defense spending this year, I have announced our plans to make further reductions of up to $3 billion in addition to the $1.1 billion in spending we announced earlier in the year.
- I am proceeding now with these plans because any delay until Congress finally acts on defense appropriations would make it absolutely impossible to make required reductions in any orderly and efficient way. Acting now, we still are compelled to inflict hardship on many of our personnel, military and civilian, whose lives will be disrupted.
- The effect of these cuts is to increase the risks to which the American people are exposed. Any further major cuts for the present fiscal year would involve even greater risks and further disruptions.

Time and again in our past history our nation has paid a frightful price for allowing its Armed Forces to dwindle to levels that proved to be too low to discourage or to counter aggression. "Too little and too late" has been the epitaph of more than one great nation in human history. I am determined that it will not be ours.

To maintain the military strength needed in the years immediately ahead, however, vigorous support of this objective by the American people will be required. I shall do my best so to manage the Defense Department as to deserve and win that support.

You who have seen war at first hand know that national weakness is not the way to peace or to freedom. You who cherish peace and freedom know that they must be protected with a keen sword and a stout shield. Pledge with me to keep the national sword and shield ready until, in God's good time, all nations learn to live together in peace and brotherhood.

Planning for Strategic Deterrence in the 1970s

Address by Hon. Robert C. Seamans Jr., Secretary of the Air Force, at the Joint National Meeting of the American Astronautical Society and the Operations Research Society of America, Denver, Colo., June 17, 1969.

My subject is a topic currently receiving great attention throughout the country. The decisions we make today will determine our national posture in the middle and late 1970's. Many of our people are improperly fed, clothed, housed, and have insufficient education and medical attention. These deficiencies demand early action. Of this there can be no question and should be no lack of support, but there is a limit to the speed with which we can solve domestic problems, just as there is minimum time required for the development, procurement and deployment of new aeronautical and space systems.

We have been making progress domestically but not fast enough. We must accelerate our efforts if we are to achieve major advances by 1975. Some may feel that our priorities at home are so demanding that we should allocate most of our national resources to them, cutting back drastically our military developments. Let me assure them that if we unilaterally lower our defenses and if a nuclear war results, the problems of our present world will seem simple indeed in comparison.

Hon. Robert C. Seamans Jr.
Secretary of the Air Force

We all agree our goal is to reduce the risk of nuclear war. The question is how to achieve that goal. I believe we must maintain our ability to retaliate even after absorbing a surprise nuclear attack. This can be done by carefully planning our future forces and by seeking effective arms control agreements.

The Soviet Threat

In planning for a nuclear deterrence, we must begin by considering the strategic threat.

The Soviets have surpassed us in numbers of ICBMs and are still building both land-based missiles and ballistic missile submarines. Counting the ICBM sites that we know to be under construction, they have about twice as much missile payload as our own ICBM and Polaris force—payload that can be very threatening to us if an expanding force is converted to multiple warheads.

They now have more than 230 ICBMs of a very large type, the SS-9, which are operational or under construction. They have tested a three-warhead version of the SS-9. Each of the three vehicles had a payload equivalent to a five-megaton warhead. If we take no action and the Soviets continue their present rate of SS-9 deployment, they could have the capability of destroying most of our land-based missile force by the middle 1970s.

Those who suggest that this is just another missile gap scare, like that of 1960, are not familiar with the developments in our detection capability in the last 10 years. In 1960 we were making educated guesses. Today the Soviet missile strength that we announce has been clearly determined. There may be more that we have not found yet, but there is no doubt about those we have detected.

Our present generation of bombers will also be increasingly vulnerable. The new classes of Soviet missile submarines may be able to reduce the warning time of an attack and catch our aircraft on the ground. The rapidly improving Soviet air defenses will make it increasingly more difficult for our bombers to reach their targets.

As to the third part of our deterrent force, our Polaris submarines, Soviet antisubmarine work continues at a high level. Even if our submarines escape detection, an improved Soviet antiballistic missile (ABM) system may be able to handle both our land-based ICBMs that survive a missile attack and our sub-launched missiles.

The Soviets have deployed a long-range system of some 60 Galosh ABM missiles. They also have deployed the Tallinn belt of defensive missiles which are thought to be primarily anti-aircraft weapons for ABM defense.

They have now tested an improved ABM which can coast or "loiter" above the atmosphere, *i.e.*, it could be restarted at altitude and directed to specific targets. Those who doubt that one missile can hit another when both are traveling at high speed should remember that the ABM can carry large nuclear warheads, which can damage incoming missiles from a considerable distance in the upper reaches of the atmosphere.

We do not know the Soviet intentions, but their ABM sites, as well as several of their other weapons, raise certain questions. So far, their ABM deployments seem to be oriented toward city defense rather than protecting their deterrent weapons, as a retaliatory posture would dictate. In fact, they continue to maintain nearly 150 soft missile sites that, because of their vulnerability, seem useful primarily for first-strike purposes. The Soviet high missile payload seems unnecessary for deterrence, but useful for attacks against missiles in hard silos. Their Fractional Orbital Bombardment System also seems designed mainly for a minimum warning attack, since it gives up payload to achieve a low trajectory. They might hope to use this trajectory to avoid early radar detection

The Value of Safeguard

Some say that we cannot protect our people from the effects of nuclear war, but in a larger sense that is not correct. If we provide for deterrence by maintaining and protecting our forces, we reduce the probability of an enemy attack and increase the probability that our people will be safe. This underlies the President's decision to proceed with the Safeguard ABM system.

Over a year ago, Dr. Harold Brown, then Secretary of the Air Force, told the Stennis [Senate Armed Services] Committee that he supported the Sentinel system for defense of our cities against the Chinese Communists. He further stated that it might be desirable at some time in the future to deploy ABM defense for our land-based missile force.

There were three new factors that caused President Nixon to propose Safeguard—a system to provide defense for certain of our missile fields. The first factor was the Soviet buildup in missile payload, as a result of SS-9 deployment. The second was the improvement in missile accuracy. Our own recent missile tests have achieved a high degree of accuracy and we would be foolish to assume that the Soviets could not do as well. The combination of Soviet payload and accuracy will make our missile silos extremely vulnerable in the middle 1970s. The third factor was the slowdown in Chinese missile development which permitted us to defer a light ABM defense of our cities.

Last year the Air Force began development of a new missile silo to reduce Minuteman vulnerability in the 1970s. But as missile accuracy continues to improve, harder silos will not be enough. We may need ABM protection to ensure that a sufficient number of our missiles would survive an attack.

The Safeguard system will put the burden on the offense. It will make it more difficult for an attacker to equip his weapons with the penetration devices necessary for successful first strike.

Moreover, Safeguard should not contribute to the arms race. It will make it more difficult for the Soviets

to destroy our missile sites in a first-strike attack, but will have no chance of defending our cities against their retaliation if we should strike first. Thus, the Soviets would not need to expand their forces because of Safeguard unless they were planning a first strike.

The ABM program proposed by the President provides an orderly step-by-step plan that can be halted at an early level of deployment, if further expansion is not required for our security. It will actually strengthen our position in arms control negotiations, since the Soviets already have an ABM of their own and might not see any reason to limit that system if they felt the United States would not build one anyway.

Need for an Improved Manned Bomber

In view of the possible vulnerability of missiles, the United States has maintained both a missile force and a bomber force to ensure against unexpected Soviet developments affecting either one of the systems.

Those who critize the bomber as an obsolete system in the missile age are often the same people who refer to our alleged 4–to–1 superiority over the Soviets in individually targeted warheads. They do not seem to realize that the ratio would be nearly 1–to–1, with total payload running heavily against us, if it were not for our bomber force with its multiple weapons on each aircraft.

If our bombers are to continue to provide deterrence, they must be able to survive an attack and then penetrate the ever-improving Soviet defenses. The B–52 is still a good aircraft, but the prototype was flying in 1952 and the latest models were produced in 1962.

An advanced bomber will take advantage of the many improvements that have been made in airframe and engine design. It would have the short takeoff and landing capability needed for dispersal and the payload, structure and speed necessary for penetration.

Over the years, we should be able to do a better job of maintaining our deterrent, at less cost, if we develop a new bomber to replace the B–52. Fewer bombers will be required, since they would be more survivable and better able to penetrate than the present bomber force.

Use of Space for Strategic Deterrence

In terms of security, the space age presents dangers, but it also affords opportunities for increasing strategic stability.

The dangers stem primarily from weapons placed in orbit. It might be possible to trigger such weapons with very little warning, thus increasing the risk of surprise attack.

The major powers have recognized the dangers. Both the United States and the Soviet Union have agreed to the Outer Space Treaty of 1967 which prohibits weapons in orbit. Both sides are watching closely to be sure there is no violation of the treaty.

Hopefully, the treaty will help us avoid the danger of weapons in orbit, while providing us opportunities for other sorts of military systems that could strengthen deterrence rather than weaken it. Any system that will give us better observation of enemy activities decreases the chances of a successful surprise attack.

Each generation of space vehicles will provide additional improvements in our ability to monitor enemy activities. We are now working on a satellite early warning system that would detect missiles as they are launched from land or sea. With the aid of such a warning system, a dispersed bomber force would be able to take off from its bases before the impact of enemy weapons, even if the time of flight of the latter were greatly reduced.

Planning for Arms Control

Arms control agreements are not incompatible with necessary improvements in our current forces. Both arms control and new weapon developments must be designed to maintain deterrence. Neither side can accept an arms control agreement unless it is certain that the proposed arms limitation will preserve its ability to retaliate against surprise attack.

Arms control agreements must structure opposing forces in a way that makes a first strike more difficult and retaliation more certain. This task should be eased by the growing realization that any effort to achieve a first strike will be countered decisively by the other side.

ABM systems that defend strategic weapons will facilitate arms control because they reduce the chance of an effective first strike. Both sides will be more likely to limit expansion of their offensive forces if the weapons they have are well protected.

Improved bomber forces also facilitate arms control. They provide insurance against the neutralization of missiles and, with their long time in flight, they do not constitute a first-strike threat against the enemy's weapons.

If no agreement can be reached to limit missile payload and ABM city defenses, then we may have to increase the size of our own offensive missile force to ensure that we can still retaliate. Unfortunately, this step might seem to the Soviets as preparations for a first strike from our side and, thus, add fuel to the arms race.

Rather than increasing our missile strength, it seems much better at this point to strengthen our deterrence with the initial deployment of the Safeguard ABM system.

The sort of balance we must plan involves a sufficient ABM system to protect one's deterrent weapons, but not enough to protect cities against the opponent's full retaliatory force.

This is a complex relationship of weapons, but one that does not preclude stability. If both sides favor arms control, both missile payload and ABM defenses can be fixed at levels consistent with deterrence.

However, an alignment of forces that can prevent war will not be reached or maintained, unless we are resolved to take whatever action is necessary to protect our own deterrent forces. If we refuse to maintain our deterrent, the Soviet Union will have no reason to stop short of a first-strike capability. At that point, any crisis situation would include the danger of a nuclear attack against the United States.

It is right for us to oppose war and to begrudge every fraction of our resources that must be allotted to the task of protecting man from man. Men should be mature enough and smart enough to live in peace with each other. I am certain that is the desire of many people here, in the Soviet Union, and throughout the world. If such an attitude takes hold, some day it will be impossible for national

leaders to take their people into wars of aggression. Nevertheless, we cannot put our heads in the sand and pretend that such a time has already arrived. We cannot let our ideals and our hopes for the future obscure the hard facts of today. We must maintain our defenses if we hope to survive to see our ideals become a reality.

In the final analysis, it is a matter of human will. We must make our scientific knowledge a handmaiden to man's hopes for a life which is both secure and beneficent. Eight years ago last month [May], President Kennedy recommended to the Congress that we commit this nation to a manned lunar landing and return in this decade. He saw the need for a program that would provide increased knowledge of our planetary environment. He saw the need for a program that would force advances in many technologies. He saw the need for a program to stretch the capabilities of many men and women. He saw the need for a dramatic program that would show ourselves and the world what the United States and, equally important, what man can accomplish when he proceeds with resolve. Next month [July], along with hundreds of million of men and women of all ages and all nationalities, I expect to participate vicariously in the fulfillment of our commitment to the lunar goal.

In conclusion, as we consider our plans for the next decade, I cannot do better than to quote President Kennedy at the anniversary convocation of the National Academy of Sciences in 1963:

> **. . . If Scientific discovery has not been an unalloyed blessing, if it has conferred on mankind the power not only to create, but also to annihilate, it has at the same time provided humanity with a supreme challenge and a supreme testing. If the challenge and the testing are too much for humanity, then we are doomed. But I believe that the future can be bright, and I believe the power of science and the responsibility of science have offered mankind a new opportunity not only for intellectual growth, but for moral discipline; not only for the acquisition of knowledge, but for the strengthening of our nerve and our will.**

The Future of the Air Force Space Program

Address by Brig. Gen. W. R. Hedrick Jr., USAF, Dir. of Space, Office of the Dep. Chief of Staff, Research and Development, Hq., U. S. Air Force, to the Joint National Meeting of the American Astronautical Society and the Operations Research Society of America, Denver, Colo., June, 20, 1969.

Our purpose of this joint meeting of participating societies is to discuss the planning needs and mission potential of the 1970s. Specifically, we should identify those most valuable space investment areas for the next decade.

There is not much question that, as a nation, we have a spectrum of very significant problems, most of which have been with us for quite some time. A number of these national problems are also pressing major military problems. One glance at the front page—at any page, for that matter—of any newspaper will certainly bear out my point. Unfortunately, in the hard, cold realism of the world in which we live, we cannot ignore one part of the spectrum of problems and work toward the solution of a separate group of problems. Progress toward the solution of our social and economic problems would be only an academic exercise if the security of our nation is not maintained.

In attempting to identify the military planning needs and mission potential of the 1970s, we should remember that due to long lead times and routine priorities, today's research will have limited influence on the immediate future of the Air Force because the early 1970s start in only six months.

Our first decade in space operations has primarily been devoted to the mastery of space. During this time of learning, we have developed some operational military systems. For example, DOD is now using 25 solar-powered satellites for reliable worldwide contact between the national authorities and our forces stationed overseas.

Plans for Coming Decade

In our second decade, we will continue to improve the operation of our military forces by developing additional space mission capabilities. However, our immediate future is primarily committed to evolution and improvement of past and current development programs, such as the Titan III, TACSATCOM (tactical satellite communications) and VELA.

Our planning for use of space in relation to other military capabilities will provide improved capabilities, such as the navigation satellite, methods for handling data generated by satellites, the relay via satellite of data from ground-based sensors, and the continued evaluation of new launch vehicles trying to achieve greater cost effectiveness.

Satellite Early Warning System Being Investigated

Of all the systems being investigated, probably the one most applicable to our continuing ability to deter a nuclear war will be an early warning system using the unique capabilities of a satellite for surveillance. The ability to detect missile launches from either land or water, and to relay this data to our decision makers, would do a great deal to preclude the possibility to surprise attack.

An enemy would have much less assurance that he could negate our strategic retaliatory forces if we have adequate warning of the attack. This will further deter a potential aggressor and help to preserve peace.

This, in turn, will provide the environment within which we can work toward solving our economic and social problems.

We are being extremely careful that our military and civilian space activities benefit fully from each other's investment and discoveries. We are working very diligently to prevent wasteful duplication of effort.

Close Cooperation Between NASA and DOD

We have been very successful in achieving close and beneficial cooperation between the National Aeronautic and Space Administration (NASA) and DOD. At the present time we have under evaluation a joint DOD/NASA space system. Of course, this system is in a very early planning stage. Such a system would, of necessity, have a transportation capability for military missions, as well as logistic support applicable to a NASA research space station or to the launch of both DOD and NASA payloads. Hence, the name Space Transportation System (STS). To provide for our future payload needs, we should examine large discretionary payloads that may be recovered and reused. Discretion suggests the substitution of propulsion capability for other missions—in place of cargo weight—as an option. The concept of reuse with the probable savings, shown in repeated studies, will receive primary attention.

The basic parameter, which will govern the choice between alternatives, is cost. Total system cost estimates are needed for research, development, test and evaluation (RDT&E) and operations, as well as the individual cost evaluations between reuse and expenditures of vehicle elements recovery method comparisons and boost concept analyses. The best possible economic studies, with emphasis on determining the cheapest among competing effective techniques, will remain as central factors in future decisions.

Brigadier General W. R. Hedrick Jr., USAF, is Director of Space, Office of the Deputy Chief of Staff, Research and Development, Headquarters, U. S. Air Force. In this capacity, he is responsible for space and space related development activities, including Air Force coordination and liaison with other government agencies. General Hedrick holds B.S. and M.S. degrees in physics from the University of Maryland.

Space Transportation System Needed in Future

Our near-term course consists of two steps. The first is the selection of an STS configuration concept to ensure that the capability for alternative missions, increased payloads, and a wider range of operational concepts receives attention.

Second, the design considerations for a future STS include:

- Keep the system reliable, yet simple.
- Accommodations and redundant systems should be contained in the STS for manned reliability and safety, but it should be designed for both manned and unmanned operational use.
- Large discretionary payloads should be considered.
- Design to launch and recover for reuse as much as possible—preferably all—of the total space vehicle.
- Spacecraft should have a night, all-weather landing capability.
- Subsonic cruise capability after re-entry, as well as an aerodynamic takeoff capability, are needed for development testing and ferrying to the launch site.
- STS design should be based on reusable features. The design should permit a simple inspection and servicing approach to refurbishment comparable, in concept, to turn-around of modern aircraft.
- Maximum performance at design operating conditions and, yet, good low-speed horizontal landing characteristics by using variable wing geometry should be included.
- Military bases, such as Edwards AFB, Calif., should be the operational landing sites.

I believe that the increasing need to have the kinds of capabilities that I have discussed will provide a positive answer to the question of the necessity for development.

In the same time period, a series of coordinated exploratory and advanced development programs will both improve existing technology and expand our knowledge in the direction of newer concepts. These specific steps will include presently identified projects, and work in areas of uncertainty resulting from the expanded analysis or recommendations by elements of the Air Force.

Potential Applications for STS

In closing, I would like to leave you with some specific thoughts on potential applications and design considerations for a future lifting spacecraft.

First, with a large discretionary payload capability, such a space transportation system could perform several missions including some perhaps unforeseen today. For a historical analogy, one can look back to the venerable workhorse of the mid-1930s which is still flying—the DC–3, or C–47, an aircraft whose many missions have ranged from cargo hauling to gun-carrying combat aircraft.

The more modern C–130 aircraft, too, has flown in many configurations—cargo, troop carrier, tanker, and as a gunship. A lifting spacecraft might indeed serve a similar purpose as a multi-mission vehicle—a C–47/C–130 type spacecraft with adaptability to changing mission requirements. As you can see, the Air Force has a marked interest in space transportation for future military missions.

As we spend this time identifying the most valuable space investment areas for the next decade, we should remember that space—like land, the sea and the atmosphere—is another medium that is available for our use. Like the water, the land and the air, space can be used for all of mankind's mutual benefit if we choose. However, the management and technical skills that permit us to operate in space have also allowed us to build weapons with destructive power beyond comprehension. Operations in space can either be used to break or keep the peace. The Defense Department efforts associated with space are to keep the peace and provide the environment within which our social and economic problems can be resolved.

Air Force Armament Laboratory

Putting the Weapon in the Weapon System

Colonel Abner B. Martin, USAF

Significant technological advances in aircraft and air munitions have been realized during the past five years; however, under tactical conditions, the ordnance-laden aircraft is not as effective as it could and should be. One of the foremost reasons for inefficiency of the air-to-surface attack system has been the lack of stringent attention in the area of interfacing air munitions with aircraft.

Historically, primary emphasis has been placed on design of the basic airframe and its associated propulsion system, with secondary attention afforded to the integration of munitions which are essential in performing a successful mission. Spectacular improvements have been realized in avionic systems and in aircraft performance parameters (speed, maneuverability, rate of climb, endurance, etc.) of a clean wing aircraft. Several improvements have also been realized with respect to the terminal effectiveness of conventional ordnance but, paradoxically, the ability to deliver weapons accurately on target has not kept pace with the other technological advances.

Even more disturbing is the fact that serious aircraft/weapon compatibility problems will persist if aircraft and armament continue to be developed independently of one another. Aircraft performance constraints, such as those imposed by excessive drag of external stores, flutter limits, and narrow delivery envelopes due to store separation problems, must be alleviated or eliminated to achieve the effectiveness desired of aircraft and munitions as a tactical system.

Hindsight clearly shows that independent development of armament and delivery aircraft, even with the application of vast national resources, produces aeronautical systems lacking in effectiveness, flexibility, safety and reliability. The goal of armament design engineers has been to provide safe, reliable and effective weapons commensurate with the performance capabilities of *inventory* aircraft. As a result, the interface between weapons and the aircraft has been fixed without due consideration to the total system. In such circumstances, the munition designer is forced to develop items compatible with existing suspension and release gear located at designated positions on the aircraft. These constraints on the weapon designer tend to inhibit conception of improved ordnance systems. Similarly, the aircraft designer has been provided with a list of stockpiled weapons to be mated with an advanced aircraft design. Consequently, many aircraft/munition interface problems remain unresolved.

Personnel responsible for aircraft and ordnance system design should be emphatically reminded that effective armament is essential to a successful mission and that the primary purpose of an attack aircraft is to serve as a weapons delivery platform. The total system development objective should be to design, develop and qualify a complete aircraft/weapon system capable of carrying and accurately delivering ordnance appropriate for its specific mission.

Delivery Accuracy

General John P. McConnell, former Air Force Chief of Staff, stated that aircraft weapon systems capable of providing improved delivery accuracy would provide a significant breakthrough by narrowing the wide gap between present-day conventional and nuclear armaments. Although aircraft performance characteristics have steadily increased, the errors associated with the delivery of weapons have also increased. A degradation in delivery accuracy is to be expected under high-speed conditions due to difficulties in target acquisition and an increase in range of weapons from the release point to the target.

Sophisticated avionic subsystems have compensated for some of these errors; however, a major source of the inaccuracy of conventional free-fall weapons results from unpredict-

Colonel Abner B. Martin, USAF, is Commander, Air Force Armament Laboratory, Eglin AFB, Fla. He was previously Chief, Technical Operations Division in Air Force Systems Command's Deputy for Limited War, Wright-Patterson AFB, Ohio. A graduate of the U.S. Military Academy, he is a command pilot and holds masters degrees in weapons system engineering from Massachusetts Institute of Technology, and from George Washington University.

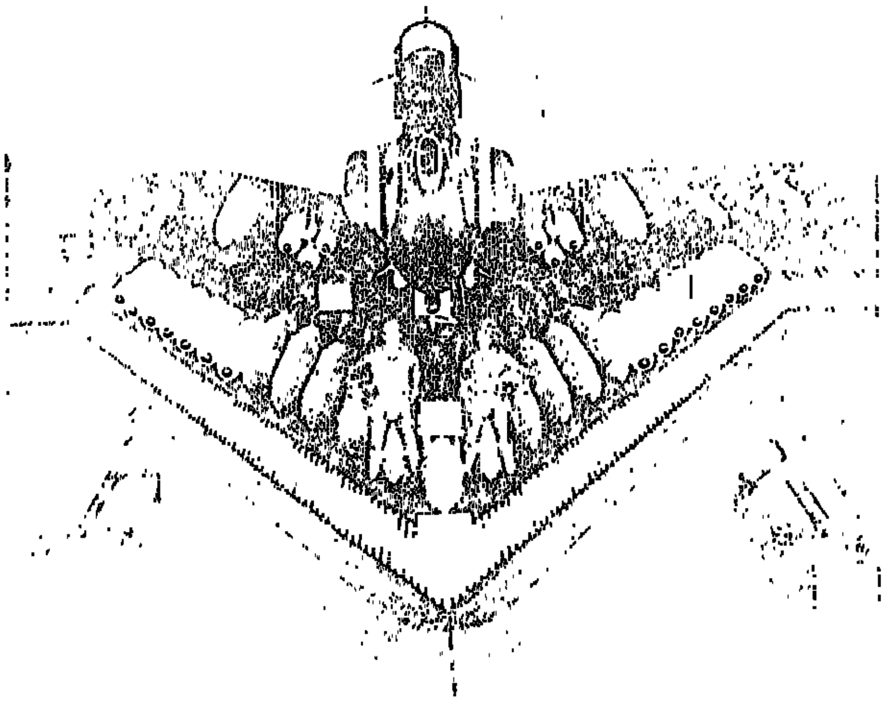
able perturbations experienced by the weapon during the release phase. These weapon perturbations result from exposure to a complex flow field which varies with each load configuration and every release condition. Considerable effort appears warranted to conceive improved suspension and release techniques which would enhance flexibility, safety and accuracy over existing methods.

Current Problems

The problems facing our tactical air forces today are not to be attributed totally to a technical lapse on the part of designers. The well known shift of national strategy which followed the Korean conflict diverted economic resources to support a nuclear policy of massive retaliation. Only token effort was directed at developing an effective conventional weapons capability (or correcting deficiencies) for coping with a limited war situation. The outbreak of hostilities in Southeast Asia necessitated retrofit and modernization of antiquated hardware, much of which had been in the stockpile since World War II. New ordnance items were hastily developed and pressed into service to be compatible with aircraft which were either designed to carry nuclear munitions or were designed initially as fighters. The outgrowth has been the continued expenditure of resources in finding solutions to urgent operational problems.

Although many compatibility problems have been resolved, our arsenal still consists of a variety of weapons and aircraft, many of which are ill-suited to each other and inadequate for their intended purpose. An example is the variety of munitions which are flown on F–4 and F–105 fighter aircraft. Fortunately, resourceful ordnance personnel have provided multiple carriage bomb racks. They have resolved some of the compatibility problems to enable use of these aircraft in an attack role. It should be noted that a similar trend of converting fighters to fighter-bombers occurred during World War II and was re-established during the Korean conflict. The need for designing an aircraft/weapon system tailored for specific roles should by now be evident.

In spite of the problem areas, airpower continues to play a major role in support of successful military operations; however, the desired levels of effectiveness have rarely been achieved.



The dual-purpose F–4 aircraft, surrounded by the variety of armament it carries in tactical operations.

Predicted Capability

Some of the reasons for current deficiencies in weapon systems have been delineated so that similar pitfalls can be avoided in the future. The lessons learned should provide guidelines for new development ideas which will eliminate many of the current production, logistic and operational problems. A science and engineering manpower pool has been established in the aircraft and armament fields, and wide recognition of the importance of an adequate ordnance program is now found in Government and industry. With this as a basis for prediction, I am confident that the breakthrough in operational capabilities to which General McConnell referred can be obtained. The technology is available and, with proper planning, management and resources, dramatic improvements can be obtained. The development program visualized will fully integrate aircraft, weapon and ancillary component designs into a total system, capable of providing the effectiveness needed in future tactical air operations.

Particular attention should be afforded to resolving logistic problems so that ready-to-use weapons are fully qualified in a factory to field operation. The design philosophies currently prevalent in the aircraft and ordnance fields should be aligned toward common goals. These goals will encompass the integration of munitions, release mechanisms, flight control systems and cockpit presentations into a system requiring the concurrent and coordinated design effort of cognizant personnel within the defense industry.

Future Efforts

To better assess the magnitude of the tasks before us, the Air Force Armament Laboratory of the Air Force Systems Command, located at Eglin AFB, Fla., has recently completed a cursory study of the problem areas, and has advocated implementation of an extensive effort involving designers, avionics experts, armament engineers and operational experts to further study and define a program for an Integrated Aircraft Armament System (INTAAS).

INTAAS is a development concept which proposes to fully integrate the design of aircraft, armament, and ancillary components into a *total* system, thereby affording maximum

effectiveness for future tactical operations. It is intended to resolve many of the logistic and tactical problems presently associated with combat operations. The INTAAS concept includes:

- Development of a new family of munitions.
- Modification of aircraft design philosophy.
- Integration of munition containers, release mechanisms, flight control systems, and cockpit presentations into a unified system.

To effect the improvements desired, all parts of the weapon system must be examined, including ordnance effectiveness, carriage and release methods, delivery envelopes, aircraft performance, crew capabilities, mission support activities, and total system effectiveness. INTAAS development will require close coordination with several Air Force laboratories, centers, system program offices, as well as appropriate elements of the Army, Navy and the National Aeronautics and Space Administration.

Design personnel from diversified technical disciplines will be used to achieve the desired total system. Designers will be required to extend their imagination in the design of munition containers and suspension systems compatible with attack aircraft. Wind tunnel tests will be conducted to further establish the feasibility of various methods of suspension and release of INTAAS stores from modified aircraft designs. Pre-fuzed munitions in the aerodynamically faired pods or containers will not require pre-flight assembly, checkout, or adjustment when employed in basic operational modes. Fuzing will incorporate automatic safing and arming systems, which are tied in with the aircraft computer, to provide a communication link between the pod and the aircraft.

Further study of the INTAAS concept will undoubtedly result in tradeoffs, modifications, and the addition of alternate or additional objectives. The following represent some of the specific objectives of INTAAS now under consideration:

- Improved performance of loaded aircraft.
- Greater delivery mode flexibility.
- Aircraft/munition system compatibility.
- Cockpit selection fuzing and arming options.
- Improved fire control systems with simplified cockpit displays.
- Simplified munitions handling and loading.
- Logistic improvements.
- Greater environmental and radiation hazard resistance.
- Improved maintainability.
- Increased reliability.
- Improved safety.
- Automated pre-flight checkout.
- Reduced aircraft vulnerability.
- Reduced radar cross-section.

The benefits to be gained by the development and implementations of the INTAAS concept are intended to be applicable throughout the entire stockpile to target sequence. Prepackaging of ready fuzed munitions would resolve many logistic problems and reduce associated manpower requirements. Handling and loading procedures are to be simplified, thereby reducing aircraft turn-around time and improving reliability of the ordnance system. The aircraft with its INTAAS-oriented payload will present a low-drag configuration for greater speed, maneuverability, and increased range to target. Improvements in delivery accuracy, and in the terminal effectiveness of weapons, would result in a fewer number of sorties flown. Although the list of objectives is long, improvements in one area, generally, represent mutual gains for other aspects of the total system as previously described. Thus, it is conceivable to incorporate most of the objectives in a system which is not overly complex.

In conclusion, it is clear that global Communist strategy will not permit the neglect of nonnuclear munitions development as has occurred in the past. Acknowledgment of present inefficiencies serves to illuminate the need for vast improvements to deal with Communist-inspired wars of national liberation in the future. The manpower and technological base capable of putting the "weapon" in the "weapon system" is available to define and design an effective system in a unified manner. The increase in operational capabilities afforded by *total* aircraft weapon system design, such as proposed for INTAAS, will provide the nation with a fully responsive instrument to deal promptly and *decisively* with any future combat requirements.

Without armament, there is no Air Force.
—Lord Hugh M. Trenchard

Lockheed Awarded Navy S-3A Contract

The Department of the Navy has announced the awarding of the contract for the development of the S-3A antisubmarine warfare aircraft, formerly known as the VSX, to Lockheed Aircraft Corp., Burbank, Calif.

The $461 million contract represents the ceiling figure to be funded over the next five years, leading to the production of six research and development aircraft. The contract gives the Navy the option of procuring 193 production models of the S-3A, dependent upon a successful development phase of the program.

Full funding of the first year's installment for the airframe—approximately $120 million—is contingent on Congressional action on FY 1970 funding requests.

An estimated 50 percent of the S-3A's cost will be for avionics.

Although covering only the research and development phase, the initial contract specifies ceiling prices for each year's production. Subsequent production contracts will be priced separately, and production options will be exercised only after satisfactory attainment of performance "milestones."

The S-3A is to replace the S-2 Tracker, which has been in service for more than 15 years. The new aircraft will be powered by two General Electric TF-34 turbofan engines, and will be capable of speeds greater than 400 knots. These turbofan engines, designed for low fuel consumption, will give the S-3A a range of more than 2,000 nautical miles. First flight of the aircraft is expected in early 1972, with fleet introduction in 1973.

Capt. F. H. Baughman of the Naval Air Systems Command has been named project manager of the S-3A program.

ILC Relocated

The Army Institute of Land Combat (ILC) has been relocated from Fort Belvoir, Va., to the Hoffman Building, Alexandria, Va. ILC shares its new headquarters with two other Army advance concepts organizations, the Advanced Material Concepts Agency (AMCA), and the Intelligence Threat Analysis Group (ITAG).

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Maj. Gen. Francis W. Nye, USAF, has been assigned as Dep. Dir., Defense Atomic Support Agency (DASA), and Commander, Field Command, DASA, Sandia Base, N.M.

Maj. Gen. Royal B. Allison, USAF, is the new Asst. to the Chairman, Strategic Arms Negotiations, Office of the Joint Chiefs of Staff, Washington, D.C.

The Defense Supply Agency has announced the following assignments at its headquarters, Alexandria, Va.: Rear Adm. Frederick W. Corle, SC, USN, has been named Exec. Dir., Technical and Logistic Services. Maj. Gen. Daniel E. Riley, USAF, succeeds Rear Adm. Ira F. Haddock, SC, USN, as Asst. Dir., Plans, Programs and Systems. Brig. Gen. (designee) Frank C. Lang, USMC, assigned as Dep. Asst. Dir., Plans, Programs and Systems. Capt. Jerome J. Scheela, SC, USN, to be Dep. Comptroller.

Capt. Gilbert S. Young, SC, USN, succeeds Col. Loren P. Murray, USAF, as Commander, Defense Contract Administration Region, Atlanta, Ga.

DEPARTMENT OF THE ARMY

Dr. J. Ronald Fox has been sworn in as Asst. Secretary of the Army (Installations and Logistics).

Lt. Gen. George I. Forsythe has become Commander of the Army Combat Developments Command, Fort Belvoir, Va., succeeding Lt. Gen. Harry W. O. Kinnard. Lt. Gen. Kinnard retired.

Lt. Gen. Henry A. Miley Jr. is the new Dep. Commanding General, Army Materiel Command.

Maj. Gen. Paul A. Feyereisen is now Dir., Materiel Requirements, Army Materiel Command.

Maj. Gen. Edward L. Rowny recently assumed the post of Dep. Chief, Office of the Chief of Research and Development, Dept. of the Army.

Brig. Gen. Darrie H. Richards has assumed command of the Western Area, Military Traffic Management and Terminal Service, Oakland, Calif.

Col. Warren D. Hodges is the new Chief of Staff, Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

Col. Donald L. Jersey has relieved Col. Clifton Duty as Dep. Commander for Acquisition, Army Aviation Systems Command, St. Louis, Mo. Col. Clifton retired.

Col. Kenneth W. Koch is the new Senior Combat Developments Command Liaison Officer to U.S. Army, Vietnam.

The Army Corps of Engineers has a new Chief of the Technical Liaison Office, Lt. Col. Richard L. Hunt, replacing Col. William K. Jordan, who retired.

DEPARTMENT OF THE NAVY

Rear Adm. Clarence E. Bell Jr. has been appointed new Dir., Navy Program Planning, Office of the Chief of Naval Operations.

Rear Adm. Walter M. Enger, CEC, was named Commander, Naval Engineering Facilities Command, Washington, D.C., and Chief of Civil Engineers of the Navy.

Rear Adm. John W. Dolan Jr. has been assigned duty as Dep. Commander for Shipyard Management, and Program Dir. for Shipyard Modernization, Naval Ship Systems Command, Washington, D.C.

Brig Gen. Foster C. LaHue, USMC, has reported to Hq., U.S. Marine Corps, as Dep. Asst. Chief of Staff (Plans).

Rear Adm. Daniel K. Weitzenfeld has become Asst. Commander for Material Acquisition, Naval Air Systems Command, Washington, D.C.

Brig. Gen. (designee) Edward S. Fris, USMC, is the new Inspector General of the Marine Corps.

Capt. George G. Ball has replaced Capt. Ernest F. Schreiter as Commander, Naval Ordnance Laboratory, White Oak, Md. Capt. Schreiter has retired.

DEPARTMENT OF THE AIR FORCE

Hq., USAF, has announced the following changes in staff assignments: Maj. Gen. Russell E. Dougherty is the new Asst. Dep. Chief of Staff, Plans and Operations. Maj. Gen. Gerald F. Keeling, former Asst. Dep. Chief of Staff, Systems and Logistics, has retired. Brig. Gen. Leslie W. Bray Jr. has succeeded Maj. Gen. Thomas N. Wilson as Dep. Dir. of Plans, Office of the Dep. Chief of Staff, Plans and Operations. Brig. Gen. Carroll H. Bolender has assumed duties as Dep. Dir. of Development, Office of the Dep. Chief of Staff, Research and Development. Brig. Gen. (designee) James R. Allen is now Dep. Dir. of Plans and Policy, Office of the Dep. Chief of Staff, Plans and Operations.

Brig. Gen. Harvey W. Eddy has taken command of the Office of Aerospace Research, Arlington, Va.

Brig. Gen. William G. King Jr. has succeeded Maj. Gen. John L. Martin Jr. as Dir. of Special Projects, Office of the Secretary of the Air Force, with duty station in Los Angeles, Calif. Maj. Gen. Martin has been named Asst. Dep. Chief of Staff for Systems, Hq. AFSC.

Other reassignments announced by AFSC include: Maj. Gen. James T. Stewart is the new Dep. Chief of Staff, Systems, Hq. AFSC; he replaces Maj. Gen. John L. Zoeckler, who has retired. Maj. Gen. Lee V. Gossick has assumed the duties of Commander, Aeronautical Systems Div., Wright-Patterson AFB, Ohio; his new Vice Commander is Maj. Gen. Edmund F. O'Conner. Brig. Gen. William S. Chairsell is now Vice Commander, Armament Development and Test Center, Eglin AFB, Fla. Brig. Gen. Warner E. Newby has taken command of the Air Force Contract Management Div., Los Angeles, Calif. The new Vice Commander, Electronics Systems Div., L. G. Hanscom Field, Mass., is Col. Paul H. Kenny.

Editor's Note: Organization charts appearing in the Bulletin are edited to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizational elements not involved in the DOD-Industry relationship have been eliminated because of space limitation.

The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.

DEPARTMENT

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

DIRECTOR Hon John S Foster Jr	3E1006	79111
DEP DIR Gardiner L Tucker	3E1014	57178
DEP DIR (ADMIN EVAL & MGT) V/A Vincent P DePoix USN	3E1030	74176
DEP DIR (ELEC & INFO SYS) G L Tucker	3E130	57345
DEP DIR (RESEARCH & TECHNOLOGY) Donald M MacArthur	3E144	55036
DEP DIR (SE ASIA MATTERS) Leonard Sullivan Jr	3E1082	74172
DEP DIR (STRAT & SP SYS) Roland F Herbst	3E130	79386
DEP DIR (TACT WAR PROG) C A Fowler	3E1040	59713
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WEAPONS SYSTEMS EVALUATION GROUP (400 Army Navy Drive Arlington Va) DIR V/A K S Masterson USN		76335
DEFENSE SCIENCE BOARD CHMN Robert L Sproull	3D1040	54157

ASSISTANT SECRETARY OF DEFENSE ADMINISTRATION

ASST SEC Hon Robert F Froehlke	[illegible]
ACT PRIN DEP ASST SEC David O Cooke	[illegible]
DIR FOR SECURITY POLICY Joseph J Liebling	[illegible]
DIR FOR INSPECTION SERVICES LtGen Hugh M Elwood USA	[illegible]
ACT DIR (ORG & MGT PLNG) Col Robert E Morrison USAF	[illegible]
NATIONAL COMMUNICATIONS SYSTEM STAFF Col Wm G MacDonald USAF	[illegible]

JOINT CHIEFS OF STAFF

CHAIRMAN JOINT CHIEFS OF STAFF Gen Earle G Wheeler USA	2E873	79121
THE ASST TO THE CHAIRMAN L/G John B McPherson USAF	2E873	79121
EXEC OFF Col C A Jackson USA	2E873	79121

CHIEF OF STAFF ARMY Gen Wm C Westmoreland	3E668	52077
EXECUTIVE Ltc Wm Steele	3E668	52110
CHIEF OF NAVAL OPERATIONS Adm T H Moorer	4E660	56007
EXECUTIVE ASSISTANT Capt J J LeBourgeois	4E672	55461

CHIEF OF STAFF AIR FORCE Gen John D Ryan	4E923	79225
EXECUTIVE Col Otis C Moore	4E929	79225
COMMANDANT OF THE MARINE CORPS Gen L F Chapman Jr	NA2004	42500
MILITARY SECRETARY Col F E Haynes Jr	NA2004	42501

ASSISTANT SECRETARY OF DEFENSE MANPOWER AND RESERVE AFFAIRS

ASST SEC Hon Roger T Kelley	3E966	52334
DEP ASST SEC V/A Wm P Mack USN	3E966	50791
DEP ASST SEC (CIVIL RIGHTS & INDUSTRIAL RELATIONS) L Howard Bennett (Actg)	3B939	76381
DEP ASST SEC (CIVILIAN PERSONNEL POLICY) Carl W Clewlow	3D976	55343
DEP ASST SEC (EDUCATION) N Brodsky (Actg)	3D258	70617
DEP ASST SEC (HEALTH & MEDICAL) Louis M Rousselot MD	3E266	72111
DEP ASST SEC (MILITARY PERSONNEL POLICY) B/G Leo E Benade USA	3C961	74166
DEP ASST SEC (RESERVE AFFAIRS)	3C956	74222
DEP ASST SEC (MANPOWER RESEARCH & UTILIZATION) Paul Wollstadt	3D257	53114

ASSISTANT SECRETARY OF DEFENSE PUBLIC AFFAIRS

ASST SEC, Hon Daniel Z Henkin	[illegible]
PRIN ASST SEC Richard G Capen Jr	[illegible]
DEP ASST SEC (OPERATIONS) Jerry W Friedheim	[illegible]
DIR OF DEFENSE INFORMATION DIR, Col R R Bankson USA	[illegible]
DIR FOR COMMUNITY RELATIONS DIR Col G F Hamel USA	[illegible]
DIR FOR PLANS & PROGRAMS DIR Col John T Merrill USA	[illegible]
DIR FOR SECURITY REVIEW DIR Charles W Hinkle	[illegible]

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DEPUTY DIRECTOR B B Lynn	4C346	46165
DEP FOR AUDIT MGT F Neuman	4A165	47323
DEP FOR RES MGT H W Kettles	4A350	47308
DEP FOR REV & EVAL J L Kiraly	4A415	47351

DEFENSE SUPP[LY AGENCY]

DIRECTOR [illegible]
DEP DIR [illegible]
DEP DIR (CAS) [illegible]
SPEC ASST FOR PUB AFF [illegible]
ASST DIR PLANS [illegible] M/G Daniel E Riley USAF
EXEC DIRECTORATE SUPPLY [illegible] M/G T H Scott USA
EXEC DIRECTORATE PROCUREMENT & PRODUCTION [illegible]
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MEETINGS AND SYMPOSIA

OCTOBER

Chauvenet Memorial Symposium, Oct. 17–18, at the U.S. Naval Academy, Annapolis, Md. Sponsors: Office of Naval Research, The U.S. Naval Academy and the Mathematical Association of America. Contact: Dr. Leila D. Bram, Office of Naval Research, Code 432, Washington, D.C. 20360, phone (202) 696–4644; or Prof. James Abbott, U.S. Naval Academy, Annapolis, Md. 21402. Phone (301) 268–7711 Ext. 552.

Fifteenth Design of Experiments in Army Research, Development and Testing Conference, Oct. 22–24, Redstone Arsenal, Ala. Sponsors: U.S. Army Research Office-Durham, and the Army Mathematics Steering Committee of the Office of the Army Chief of Research and Development. Contact: Dr. Francis G. Dressel, Mathematics Division, U.S. Army Research Office—Durham, Box CM, Duke Station, Durham, S.C. 27706. Phone (919) 286–2285, Ext. 75.

Biochemical and Pharmacological Aspects of Climatic Stress Symposium, Oct. 27–29, at the U.S. Army Research Institute of Environmental Medicine, Natick, Mass. Sponsor: Department of the Army. Contact: Dr. A. H. Hegnauer, Research Program Officer, U.S. Army Research Institute of Environmental Medicine, Natick, Mass. 01760. Phone (617) 955–2814.

Mathematical and Computer Aids to Design Symposium, Oct. 27–31, at the Disneyland Hotel and Convention Center, Anaheim, Calif. Sponsors: Office of Naval Research, Society for Industrial and Applied Mathematics, Association for Computing Machinery, and the Institute for Electrical and Electronics Engineers. Contact: Dr. Leila D. Bram, Office of Naval Research, Code 432, Washington, D.C. 20360, phone (202) 696–4644; or Dr. W. J. Jameson Jr., Collins Radio Co., Cedar Rapids, Iowa. 52406. Phone (215) LOcust 4-2929.

Navy Contract Aerospace Services Symposium, Oct. 29, at the Hotel America, Washington, D.C. Sponsor: National AeroSpace Services Association. Contact: Harry S. Baer, Executive Director, 1725 DeSales St. NW, Washington, D.C. 20036. Phone (202) 393–0211.

NOVEMBER

Second Annual Armed Forces Audio-Visual Communications Conference, Nov. 3–7, at the Sheraton-Park Hotel, Washington, D.C. Sponsor: Department of the Army. Contact: HQUSAF (AFXO-TV), 2–AFAVCC Registration Committee, Washington, D.C. 22030. Phone (202) 693–2615.

Fifteenth Annual Army Human Factors Research and Development Conference, Nov. 4–6, at Fort Ord, Calif. Sponsor: Behavorial Sciences Division of the Office of the Chief of Army Research and Development. Contact: Lynn E. Baker, U.S. Army Chief Psychologist, Behavorial Sciences Division, Office of the Chief of Research and Development, Department of the Army, Washington, D.C. 20310. Phone (202) OXford 4–3693.

VTOL Environmental Requirements Symposium, Nov. 17–18, at Arlington, Tex. Co-sponsors: Aeronautical Systems Division (AFSC), American Helicopter Society and the University of Texas. Contact: Mr. Kuehne, Aeronautical Systems Division (ASZT), Wright-Patterson AFB, Ohio 45433. Phone (513) 255–3224.

Magnetism and Magnetic Materials, Nov. 17–20, at the Benjamin Franklin Hotel, Philadelphia, Pa. Sponsors: Office of Naval Research, the Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, the American Society for Testing and Materials, the Institute of Electrical and Electronics Engineers, and the American Institute of Physics. Contact: Dr. Hugh C. Wolfe, American Institute of Physics, 335 E. 45th St., New York, N. Y. 10017. Phone (212) 685–1940.

Fourth Naval Training Device Center and Industry Cost Effective Training Devices Conference, Nov. 18–20, at the Naval Training Device Center, Orlando, Fla. Sponsor: Naval Training Device Center. Contact: D. Robert Copeland, Conference Coordinator, Code 421, Naval Training Device Center, Orlando, Fla. 32813. Phone (305) 841-5611, Ext. 664.

Titanium Technical Conference, Nov. 18–20, at Dayton, Ohio. Co-sponsors: Air Force Materials Laboratory and the University of Dayton Research Institute. Contact: Dr. Gegel, Air Force Materials Laboratory (MAMS), Wright-Patterson AFB, Ohio 45433. Phone (513) 256–5561.

DECEMBER

Eighteenth International Wire and Cable Symposium, Dec. 3–5, at the Shelburne Hotel, Atlantic City, N.J. Sponsor: U.S. Army Electronics Command. Contact: Milton Tenzer, Symposium Chairman, Electronics Parts and Materials Division, Electronic Component Laboratory, U.S. Army Electronics Command, Fort Monmouth, N.J. 07703. Phone (201) 535–1834.

Third Circuits and Systems Conference, Dec. 10–12, at Pacific Grove, Calif. Sponsors: Naval Postgraduate School, the University of Santa Clara, Stanford University, and the Circuit Theory and Automatic Control Group of the Institute of Electrical and Electronic Engineers. Contact: Sydney R. Parker, Naval Postgraduate School, Monterey, Calif. 93940.

Master Planning the Aviation Environment Symposium, Dec. 17–19, at Del Webb Townhouse, Phoenix, Ariz. Sponsors: Arizona Department of Aeronautics, Arizona State University, and Luke AFB, Ariz. Contact: James Vercellino, Director, Arizona Department of Aeronautics, 3000 Sky Harbor Blvd., Phoenix, Ariz. 85034. Phone (602) 275–9169.

Forecasting Future Military Missions and Their Technological Demands

Dr. Donald M. MacArthur

The day-to-day management of Defense Department research and development, which is the current work of many of us, is in a sense nothing but forecasts. We must try to forecast potential threats. We try to forecast the potential of various fields and scientists that compete for our resources. We try to forecast the costs and payoffs of various development plans. As a regular part of management, we compare our past forecasts and plans with our current performance.

But the single most important job of defense research and development is to think—and think hard—about the options and the capabilities which the President and the Secretary of Defense may need in the future. We try to do this. Usually when we finish, we have a long list of projects designed to guard against a range of contingencies and to prepare for a range of sometimes relatively improbable needs. At this point, of course, the list is cut based upon the national priorities and the budgetary constraints. The crucial point, however, is that research and development is in the *option-creating* business, leading to ways of fulfilling national commitments with *alternative* methods, building *new* understanding of the interactions between policies, missions and technologies.

Overall, even though much of our business could be regarded as forecasts, we usually do not think of it that way. Too often there are unexpected problems, new solutions, unforeseen issues, unpredictable events. The Defense Department may be asked to carry out a mission on short notice which no one anticipated and this perhaps distinguishes defense research and development from the research and development supporting other national goals. In fact, the interaction of national policies, missions and technologies is clearly a "chicken-egg" phenomenon. New technology has forced decisions on new national policies and major missions—this happened with ICBMs. And a major policy decision can create a new mission and stimulate new technological requirements—this happened with our space program.

Once we understand that any mission-oriented research and development activity is inevitably in the forecasting business and in the business of influencing the future, we then see it is *both* the choice of long-term policies and missions, and the future technologies, which lie at the *heart of the forecasting problem.* Before going further, there are two obviously serious problems in developing this discussion. First, some of the detailed information central to an understanding of DOD's possible future missions is classified. Second, our crystal ball is neither panoramic enough nor blessed with high enough resolution to allow us to feel comfortable.

With these limitations in mind, this article will cover three areas:

- Interactions between choices of national goals and choices of military missions.
- Framework for thinking about the emphasis among possible future missions.
- Range of forecasting techniques and activities which DOD has employed and an indication of what they suggest about technological growth areas.

National Goals

To begin, we must understand our national objectives. Many experienced in national security affairs are today concerned with a reappraisal of past commitments in the light of our experience in Vietnam and the prospect of strategic arms talks with the Soviet Union. In Congress and on many university campuses, questions such as these are being raised: What is required to deter nuclear war? What kinds of arms control treaties are in the national interest, and how can they be enforced and how can we best handle our defense needs under the changed circumstances? What forms of defense alliances are needed, and how can they be made even more effective, in the future? What levels of standing forces do we need and how should they be deployed in association with our allies? Have the roles of air, land and sea power changed—and if so, what will we need in the future? Given that national security

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must be assigned a top priority in our Federal budget, taking account of our many pressing domestic needs, how much do we need to spend on defense?

Essentially, these questions and many other ones are continually under review. President Nixon has a series of studies underway now to reassess our national security policies.

The choices posed by the questions are so complex, and have such broad political and military significance, that the follow-up work on details of alternative military missions is comparatively straightforward. There are scores of branch-points in terms of differences in the relations among major powers and minor powers, in the likelihood of military action, and in the kinds of contingencies in which our forces might become involved. To discuss all of the possible outcomes and their implications would require much more space than is available here.

Thus, let us make a few assumptions, while recognizing the hazards involved in trying to state hypothetical national objectives.

Let us consider, first, that the guiding national policy will be to continue to work for a peaceful world in which nations settle their differences without resort to violence. It seems clear that to do this, the United States will continue to require a strategic nuclear deterrent sufficient in *both* size and technological quality to represent a clear *and* credible capability. This objective would be consistent, of course, with a range of possible arms control agreements. It also seems clear that general purpose forces will be needed to complement the strategic deterrent through a capability for deterring—and defending, if necessary—against lower levels of violence. The likely future size and basing of our general purpose forces are difficult to estimate because costs and the structure of alliances are key variables, on which judgments must be made at the highest level of our Government.

Military Mission Trends

With just this general framework of national objectives, we can begin to consider the trends in possible military missions.

Let us then consider the general categories of operational capabilities that appear to be what we have already decided we want in the foreseeable future. Assuming that strategic nuclear deterrence will remain the primary objective and that supporting military forces will be designed to deter lower-level conflict and to prevent escalation should conflict nevertheless occur, we will need continuing improvements in at least the following seven areas:

- First, and most important, continued emphasis on all of the equipment required for a sufficient and credible strategic nuclear deterrent in the face of what we can expect to be considerable uncertainties about growing Soviet and Chinese capabilities.
- Second, we will need to continue to improve our *all-weather, all-climate* fighting, capability, including our ability to hit targets *much more accurately* than we can today and at a cost commensurate with the *value of the target*. Another revolutionary concept first tested recently in Vietnam is the ability to provide around-the-clock, real-time battlefield surveillance.
- Third, high reliability and greater flexibility so that overall costs, and particularly logistic and maintenance requirements, can be minimized.
- Fourth, mobile and flexible deployment systems in small units, capable of rapid integration into larger units, sufficient to stop trouble before it breaks into major conflict.
- Fifth, much better understanding of the relationship among the military, political, economic, technical, and psychological factors influencing successful deterrence along both the strategic and tactical dimensions of the use, or the threat of the use, of force.
- Sixth, strategic and tactical intelligence and surveillance data collection and processing systems.
- Seventh, strategic and tactical real-time, comprehensive command-control communications systems that allow detailed handling of dispersed units in crisis situations.

The third and fourth areas in this short but demanding list are especially critical if only because we too easily take them for granted and, thus, tend to dismiss them.

The costs for new defense systems must be reduced, wherever possible, consistent with our goals and commitments, even if we revise our goals and commitments. One way to do some of this is to seize all of the revolutionary opportunities emerging for very high reliability equipment. On the other hand, high reliability can also be achieved through extremely simple and durable designs, *e.g.*, in ground combat and communications equipment, which may be relatively inexpensive both to purchase and to maintain.

The tasks are to examine precisely what performance is required, and then to carry out an explicit analysis of the purchase costs and the long-range costs required to achieve the *necessary* reliable performance. Many new systems must, of course, have new, complex and costly components. In general, however, our trend in the future will be toward using long-term cost as an even more decisive criterion in selecting the level of sophistication of subsystems to incorporate into new systems. In some cases, this will mean a sacrifice in our performance goals to make sure that we achieve higher reliability objectives and reduce costs. Much broader test and evaluation programs will be required to ensure that we meet these reliability objectives.

The fifth area mentioned is a reminder that we must deepen and broaden our interdisciplinary studies of deterrence and defense, of the steps needed for successful arms control, and of the tactics required for successful deterrence of local low-level violence. This is complex, often controversial work drawing on the social sciences.

Future Technology

We have now looked briefly at the problem of national policy choices and military missions. Next, we should look at the trends in potentially useful technologies. In starting this task, we are again confronted with great complexity. How do you forecast the directions of growth of technology to satisy likely missions? Are there analytical tools available to help with such a job?

The answer is mixed. While there has been a considerable amount of successful work in forecasting and in the development of useful forecasting aids, it is fair to say that the field is still evolving. We can be more systematic and mathematical than the ancient prophets. Planning, forecasting, or prognosticating may seem formally easier now, but they still seem little better than the insight of those who practice this difficult profession.

It is basically *long-term* forecasting that is difficult—15 to 20 years or

more ahead. When we try to look 5 to 10 years ahead, the military needs are rather clear and the research and development paths are rather obvious even if the technology is not immediately available. In part, this is because of long development times. Farther into the future, few can make accurate predictions because scientific advances will create new options for *both* missions and the technologies in fulfilling old and new missions. Because of the long-term forecasting problem, we believe we must support a broad research program that "covers all bets." However, we do try to identify certain areas for emphasis which seem to possess "high-leverage" in solving national security problems.

In addition to our in-house work, we ask independent ad hoc task forces of the Defense Science Board to think hard in rather specific ways about the future needs of DOD. For example, the Director of Defense Research and Engineering asked, "Just what might his successor in 5 to 10 years wish had been started?" The task force, chaired by Dr. Simon Ramo, considered topics within the context of major developments in the 1980s that could be relevant to national security. The topics included the following, which are mixed between our problems and our technologies—what you might call our sicknesses and our cures:

• **Search, Identify and Destroy Missions.** Improvement in the battlefield surveillance and command and control will permit the rapid deployment of land forces, to seek out and destroy the enemy while he is on the move at night or in bad weather. The capability to use laser-guided weapons, under all environments, will be routine for airborne attack. Self-contained night and all-weather interdiction aircraft systems will detect, identify and destroy both fixed and fleeting targets, using a computerized system of sensors, communications and weapons. This will require improved navigational and terrain avoidance systems expected to be available by the early 1980s.

• **The Interdependence of Social, Technological, Economic, Military and Political Factors.** By the early 1980s, we can expect to have moved substantially beyond the present haphazard way in which these different considerations are related to each other. Military planners and defense managers of that period will be supported by extensive banks of information, based on observations of importance to DOD, made over a period of time, and computerized models. They will use these to distinguish between those interaction effects which are likely and those which are unlikely. Seated at a console, they could suggest alternative courses of action, run through the model, and receive back analysis of the probable major consequences. Similar methods could also be used to train personnel in these complicated and interrelated areas.

• **Accelerated Learning Techniques.** The formal classroom, standard curriculum, the fixed schedule of instruction will all be things of the past. DOD will employ a small number of massive central processing computers which will support 5 to 10,000 consoles for military students at distant locations. Defense Department personnel will be engaged in a continuous learning process in their field of primary interest of responsibility, *e.g.*, vocational, scientific, managerial. Supported by new forms of educational technology, they will learn according to their own speed and style. The hours of instruction will be those they choose. The place of instruction will be wherever they are located.

• **Lasers.** Foreseen new devices are tunable lasers which will give us the ability to do in the optical region what we can do today in the microwave region, *i.e.*, heterodyning, mixing, etc; and parametric conversion devices which would enable us to utilize the best techniques for a given problem. The key here is the expected availability of non-linear materials which can operate in optical regions.

• **Materials Development.** Incidentally, materials will continue to be the foundation of our success, and often the reason for our failures, in new systems of all kinds. The use of composite materials in aircraft should yield a weight savings of up to 50 percent which will double the range, or double the payload, or increase loiter time. New materials for lift engines will allow for increased payload of between 25 to 50 percent and a doubling of the thrust/weight ratio. We can look forward to manned transparent glass submersibles, capable of exploring and patrolling at depths sufficient to examine most of the oceans' bottoms. In space satellite applications, materials will be developed which will last for periods up to 15 years without degradation.

• **Identification of Friend or Foe (IFF).** Development of stand-off weapon systems demand that there be commensurate improvements in IFF equipment. It is hoped that technology can provide airborne IFF equipment that will permit firing weapons at maximum weapon range with minimum chance of revealing our aircraft position.

• **Computer-Based Information Processing and Pattern-Recognition Systems.** While present practical applications of these techniques are evident in character recognition devices we are familiar with (such as optical and magnetic character recognition for bank check accounting and retail store receipt compilation and accounting), there has been little day-to-day use in the military. In the next few years, however, we will be using these technologies in reconnaissance, surveillance, and data transmission.

• **Ocean Sciences and Engineering.** In the 1980s, our capabilities should permit us to go anywhere in the world's oceans at any time and at most depths. Nuclear reactors will be operating as power generators on the ocean floor. Airports will be constructed offshore and living on the ocean bottom can be commonplace for recreation and scientific investigations.

• **Weather Prediction and Modification.** Because weather depends on known scientific phenomena, and data can be secured and computer processed, worldwide weather conditions will be forecasted with greater accuracy for 30 days longer. Ultimately, everyday forecasting will be quite accurate through computer prognoses and worldwide satellite coverage of many more meteorological parameters. Accurate measurements from satellite-based sensors, particularly above 10,000 feet, will replace individual soundings now taken at multiple points on the surface, and will be coupled with inputs from atmospheric, water surface and underwater sensors. Weather modification techniques will be available for almost any type weather condition and limited in its extent only by legal, political and social demands.

• **Cryogenics.** Superconducting materials and devices are expected to be routinely used for computers and a

variety of electronic devices, enabling large savings in power consumption, smaller size and more efficient operation.

Obviously, this is an enormously broad and challenging array of topics. One of the most refreshing and useful characteristics of Dr. Ramo's work was that the recommendations were brief, and depended on qualitative reasoning based upon a realistic analysis of the current military and scientific situation. There is simply no substitute, when trying to forecast, for an understanding of the current situation. Someone once said that all the really good ideas he ever had came to him while he was milking a cow. Few of us milk cows these days. However, those who make military or technical forecasts relative to military systems should really know military or technical operations. If they do not, their forecasts can be no better than skimmed milk.

Forecasting: Which Direction?

In the past there has been continuing work on forecasting. Much of the long-range forecasting has been frankly labelled intuitive or judgmental. An expert—military or scientific—would simply make an analysis of what he believed would evolve in the future. Sometimes experts have gotten together to compare and criticize projections, and then develop a consensus viewpoint.

Other forecasting has been and is done in a more detailed way. Past trends can be plotted numerically and then compared or extrapolated. Analogies can be made and tested. Curves can be drawn for characteristics of fields large and small, and then adjusted to suggest either goals or expectations.

The Defense Department, since World War II, has contributed to many of these pioneering activities in forecasting and related enterprises. Reports have been commissioned by distinguished scientists and managers. Organizations have been established to concentrate on thinking about long-range issues. Retrospective analyses have been performed to document those lessons of the past that might be relevant to "managing" the future. As most of you know, each of the Military Departments today has groups of analysts trying to develop and analyze long-range requirements. Special experiments are being run to explore new ways of meshing requirements with allocations of research and development resources.

This article has covered the range of forecasting activities and a list of assorted topics to underscore one fundamental point. It is simply not possible today, given the broad range of defense missions and the almost bewildering pace of technological development, to predict with great confidence what *specific* shifts will occur in either missions or technological demands. Forecasting efforts are worth our investment only in the sense that they define the broad boundaries of our choices a bit better. They rarely provide detailed answers about what we need in the long term. The reason they do not—or perhaps more accurately, the reason they cannot—is simply that much of the future will be governed by our decisions rather than dominated by some impersonal factors that can be plotted and calculated. The country must decide on its commitments, and research and development must provide practical alternatives for fulfilling them. What is quite clear, then, is that the Defense Department must and will sustain a strong commitment to all of the research fields related to national security.

Our broad missions and our overall research and development needs are clear. Certainly the war in Vietnam has revealed many of our strengths and a number of our weaknesses. In the next 10 to 20 years, there will be no decrease—in fact, there will probably be an increase—in the strong dependence of national security upon advanced technology. We will be relearning and re-applying all of the lessons learned in past conflicts to ensure that our future forces will be even better prepared for whatever they are asked to do.

We can take as a guideline the quite remarkable comment of the English scientist Michael Faraday who, when asked by a politician what good his discoveries in electricity were, answered: "I do not know yet; but some day you will tax it." So it is with national security and technology. Today's laboratory curiosity may be the basis for tomorrow's national defense. No statements of long-term "likely missions" and long-range technological developments will anticipate all of what probably will occur.

The challenge to all of us is to think through the basic requirements of national security for the last third of the 20th century and do what is necessary for our preparedness. This is quite a challenge. To meet this challenge, we need great skill and a sure sense of our responsibilities to the country.

Electronics Component Conference Calls for Papers

The 20th Electronics Components Conference, to be held May 13-15, 1970, at the Statler-Hilton Hotel in Washington, D.C., has called for papers of presentations. The conference, sponsored by the Electronic Industries Association and the Parts, Materials and Packaging Group of the Institute of Electrical and Electronic Engineers, will include sessions on materials, passive components, hybrid integrated circuits, interconnection and packaging, filters and networks, and new functional devices.

Abstracts, with a minimum length of 250 words, along with a list of papers, salient concepts and features, are due by November 15. Four copies of the abstracts should be sent to Darnell P. Burks, Technical Program Chairman, Electronic Components Conference, Sprague Electric Company, Marshall Street, North Adams, Mass. 01247. Authors will be notified of acceptance by January 1, and final manuscripts will be due March 1.

Improved Windshields Sought by Army

Detachable, shatterproof windshields for tracked combat vehicles have been proposed by the Army Combat Developments Command, Fort Belvoir, Va. In addition to providing protection for drivers and commanders in arctic and cold weather climates, the shields would also deflect gravel, dust, water and other substances from the faces of personnel.

The windshields would provide protection from winds from side angles of up to 45 degrees, and would be spring loaded for quick release and mounting. CDC sees the windshields applicable to personnel carriers, tanks and self-propelled artillery pieces.

Weapons To Survive Nuclear Attack

Colonel David R. Jones, USAF

The term "survivability/vulnerability" has recently come into widely accepted use within the Defense Department, and it has special significance when related to nuclear weapons effects. Together, the words imply an awareness of the interplay between employment and design of strategic weapon systems. Separately, and carefully defined, the terms spell out a new philosophy in weapon system development.

The vulnerability of a weapon system to a nuclear environment is defined as the inherent hardness of that system; its ability, because of design, individual components, operating features, etc., to withstand the effects of a nuclear detonation. This hardness may be spelled out as a set of numerical values for the nuclear effects expected to be encountered. If these values are exceeded, the weapon system will be unacceptably degraded in performance. These values are arrived at by experiment and analysis, and are subject to change only when something about the weapon system is changed. Changes may run the gamut from simple substitution of more radiation-resistant electronic components, to the redesign of missile silos to withstand higher overpressures.

The nuclear survivability of a weapon system may be defined as the capability of that system to perform its designated mission in a nuclear environment. Survivability is a complex term made up of several elements which must be considered individually and in combination with each other. The system planner must decide what kind of a system he wants, what he wants it to do, what it will operate against, and how much money it will take to build it. All of these elements ultimately enter into the survivability calculation. Some of them are highly speculative, and may never be known to a high degree of accuracy. For example, a planner's knowledge of the nuclear threat to a system is limited by inexact information of an enemy's capability and intention. With a completely conservative approach, he might grant the enemy an unwarranted capability and price himself right out of business, trying to design a system to survive in too extreme an environment. In the same way, some nuclear vulnerabilities may not be known to the degree required for careful system design, either because we do not know how to make the required measurements or making them takes a great deal of time and money.

Of the elements involved in the survivability equation, the nuclear threat is undoubtedly the most fluid, but the least adjustable. The mission profile can be adjusted within the limits of the system capability to avoid catastrophic environments, and the system vulnerability can be reduced, at some cost, by design changes or substituting more reliable components. However, the threat is only amenable to better definition. In addition, since the threat is based on the state of technology of a country, it must be treated as a dynamic element because of the constant growth in technology. This necessarily implies that today's system, or one that is being developed to go on the line five years from now, may be obsolete as it comes into the force, if the threat treatment is not adequate.

Elements of Threat and Cost

The other elements of the survivability/vulnerability equation are to a large degree dependent on the threat, but they are also highly sensitive to the element of cost. It may not be possible to harden a system, *i.e.*, reduce its vulnerability to a particular nuclear weapon effect without spending large and, perhaps, prohibitive amounts of money. On the other hand, it may not be necessary, if analysis shows that the system is not going to be exposed to critical levels of that nuclear effect. The mission profile may be designed within the performance limits of the weapon system, to avoid these critical levels. In many cases this cannot be done, and the vulnerability of the weapon system must be reduced in order to achieve a reasonable probability of survival.

Still another method of increasing the chances of survival is the use of countermeasures. These generally have the net effect of reducing the probability of detection and intercep-

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tion, and act to improve the survivability of the system. Considering all of these elements in the survivability/vulnerability equation, and the uncertainties involved in the highly speculative threat determination, it should be readily apparent that the survivability of a weapon system is not easily determined, especially when the uncertainties in our knowledge of weapon effects are added to the picture.

Effects of Principal Concern

The various nuclear weapon effects that figure in the study of weapon system vulnerability have been well catalogued. Their importance to survivability, however, has not always been appreciated nor understood. Today a much more enlightened attitude prevails, and system planners and project managers are required to consider the nuclear vulnerability of their weapon systems during the design and development phases of the systems. The effects of principal concern are:

• Ground Shock. This is the motion induced in the earth by the passage of the air blast from a nuclear detonation, or by directly coupled energy from the detonation. The crater formed by the surface detonation scours out debris which is distributed in the vicinity. All of these are close-in phenomena, and must be considered in examining the vulnerability of hardened sites and complexes.

• Electromagnetic Pulse (EMP). EMP is the pulse of electromagnetic radiation resulting from the interaction of nuclear weapon radiation with the atmosphere. Since the rise time is short, it can induce large electric currents in conducting materials, like power lines or missile skins, burning up connectors, damaging components, or introducing spurious signals into computer equipment. Air does not attenuate the EMP environment and the geometrical fall-off with distance is very small. Thus, the EMP environment occupies larger volumes than nost weapon effects.

• X Rays. These are intense pulses f thermal radiation in the X-ray egion of the radiation spectrum hich are emitted during the early imes of a nuclear detonation. Since hese X rays are rapidly absorbed in ir, their range in the atmosphere is mall. The X-ray environment is of greatest concern in space, where it may well be the dominant kill mechanism for satellites or reentry vehicles.

• Transient Radiation Effects on Electronic Systems (TREES). Nuclear particles and radiation from a nuclear detonation can damage or cause malfunctions in electronic components through ionization. Ionization may overload a critical element or create spurious pulses and, thereby, possibly cause system failure.

• Air Blast. The rapid and local heating of the air by the nuclear detonation produces a shock wave which rapidly decreases in intensity with distance. Since it is atmosphere dependent, it may be important in vulnerability considerations of aircraft, missiles in the boost phase, and unhardened communications system. As mentioned before, the close-in air blast is important in producing ground shock.

• Thermal. Conventional thermal radiation, unlike X rays, is a long-term phenomenon in the history of a nuclear detonation. It is produced by the glowing fireball, and its effect is mainly observed on those systems components which are susceptible to heating over periods as long as a few seconds.

• Crew Radiation Dose. This is the radiation dose which the crew receives from the gamma ray and neutron output of a nuclear detonation. It must be specified in terms of total dose and dose rate, since both have been shown to be important. For vulnerability analyses, the dose which incapacitates a crew, rendering it unable to carry out the mission, is of greater importance than the median lethal dose, where there is at least a 50-percent chance that the crew would be able to complete the mission.

• Blackout. This may be described as the disruption or disturbance of normal radar communication system operation as the result of interaction of bomb output with the upper atmosphere. The effect tends to be frequency dependent and may last for several days on such things as long-range communications systems, and only a few tenths of a second on some radars.

• ARGUS. A nuclear detonation which occurs above the earth's atmosphere injects charged particles, principally electrons, into the earth's magnetic field lines. These are trapped in the field, forming an artificial belt above the Earth. The electrons are gradually removed in collisions with the atmosphere, and the belt decays in intensity. The seriousness of the ARGUS effect on satellites and manned space vehicles is a function of the yield of the weapon detonated and the location of the detonation. Satellite solar cells tend to be particularly vulnerable to electron bombardment.

Threat Level Environment

For each of these effects, a series of threat level environments may be developed which correspond to the enemy threat postulated. The threat level environments developed must be examined for applicability to the weapon system mission profile. For instance, manned aircraft weapon systems are principally vulnerable to air blast, thermal radiation, crew radiation, and TREES, but long-range effects on communications caused by EMP and blackout may also be important. A complete and thorough analysis of the mission profile and threat will reveal which of these effects are important to the system, where in the mission profile they will be encountered, and their relative degree of importance to the successful completion of the mission.

Having determined the complete threat environment in which a system survives, the system developer must find a way to test to that threat level, in order to establish a degree of confidence in the weapon system's survivability. A full-scale nuclear test would provide the opportunity to test in a realistic environment. However, nuclear tests tend to be very costly, complicated, and fraught with many experimental difficulties. The isolation of one effect from all others is very difficult, and the expense of a single test makes repeating a measurement as often as an experimenter would like rather infeasible. Even if full-scale testing was possible, however, it would supplement, in many cases, the simulating techniques currently in use, and would not supplant them. *Fortunately, a great deal of progress* has been made in developing the weapon effects simulation techniques needed for vulnerability testing. In some cases, a realistic environment may be simulated; in others, the predicted response of the weapon system or a component to that environment may be reproduced.

Search for Simulation Techniques

The need for the development of simulation techniques became apparent with the establishment of the unilateral moratorium on nuclear testing in 1958. Earlier, efforts in the TREES area had led to the use of flash gamma-ray tubes and nuclear reactors, trying to achieve the radiation doses and dose rates necessary for damage studies in electronic components. With the moratorium came the realization that the strategic and defensive posture of the nation would be vitally affected, if means were not found to simulate or reproduce other important nuclear effects. The nuclear effects community is still hard at work on that problem. Megavolt gamma-ray units have since been developed and these, with pulse reactors, give the experimenter an opportunity to study the response on electronics in a realistic environment.

In the X-ray field, in 1959, work was begun on the development of a hydrodynamic computer code to predict X-ray damage to reentry vehicle materials. This was combined with an experimental technique, using flyer plates accelerated by the discharge of condenser banks to study damage mechanisms. Out of this work was obtained a good approximation to the solution of the X-ray problem. In 1952, the first significant effort was made to solve the theoretical problems associated with EMP. These studies ultimately led in 1965 to the development of experimental devices which, by 1967, were capable of producing threat level EMP environments in which the response of whole weapon systems could be realistically tested. In the ground shock area, the high explosive simulation technique (HEST) was developed in 1964. This technique permitted studies of the response of hardened missile site components to ground shock effect. It has since been expanded and is now capable of testing entire segments of complexes. With the growing interest in very hard missile sites, new techniques are being developed to extend the range of overpressures covered by the HEST technique.

The nuclear weapons effects research and technology program of the Defense Department has been the source of most of the simulation technique developments. This program, administered by the Defense Atomic Support Agency and carried out by the laboratories of the Army, Navy and Air Force, falls in the category of exploratory development. In the last few years, as weapon system developers have become increasingly aware of the vulnerability problem, more and more engineering development funds have been available to adapt the simulation techniques to weapon system testing. The trend will probably continue.

Mission of Air Force Weapons Laboratory

Within the Air Force, the Air Force Weapons Laboratory (AFWL) is charged with the responsibility for ensuring that Air Force weapon systems meet hardening criteria. This laboratory, located at Kirtland AFB N.M., manages the Air Force research and technology programs in nuclear weapons effects, including simulation development and participation in underground nuclear tests. In 1967, AFWL was charged with the task of supporting the systems divisions of the Air Force Systems Command (AFSC) in their survivability/vulnerability programs. This has included developing analysis techniques which may be used as guides in system vulnerability studies, developing simulators and testing techniques for measuring system vulnerability, and reviewing engineering changes being incorporated in the system to determine their impact on system vulnerability.

The Air Force Special Weapons Center (AFSWC), also located at Kirtland AFB, has a capability to test weapon systems for vulnerability levels, using the simulation techniques developed by the laboratory. AFSWC provides an analysis capability as well. The two organizations work closely together on survivability/vulnerability problems. An example of this relationship is the HEST series, in which AFSWC took the basic technique for simulating air-induced ground shock as developed by AFWL, and applied it to operational missile sites to check their hardness to ground shock.

A considerable portion of AFSWC and AFWL manpower resources are devoted to the survivability/vulnerability work. In AFWL, 45 percent of over 900 persons assigned are devoted entirely to some aspect of the problem. Most of this investment is concentrated on the major weapon systems managed by the systems divisions of AFSC. In addition, Air Force operating commands, such as the Strategic Air Command and the Aerospace Defense Command, as well as Army and Navy systems offices, are requesting an increasing amount of assistance, especially in the analytical and simulation testing areas.

Fundamental to all of the survivability/vulnerabilty capability at AFWL is its computational techniques and facilities. This capability is manifested in a unique combination of two Control Data Corp. Model 6600 computers, coupled together through an extended core storage, enabling the laboratory to undertake theoretical problems of a complexity unthinkable a few years ago. The essential elements of this computational capability are the people of the laboratory who have learned to develop and adapt complex computer codes, and to solve otherwise intractable problems using these computers.

Continuing Need for Industry Support

Notwithstanding existing capability, AFWL and AFSWC together cannot provide all the analytical and simulation testing work required by the Air Force system program offices (SPOs). There are many weapon systems in the Air Force which must survive in hostile nuclear environments. The degree of severity of these operational environments varies from one system to another. Each of these systems must be examined in the environment in which it will have to operate, and means devised to correct deficiencies where indicated.

Industry offers the only real reservoir of talent to carry out the bulk of the work. This is particularly true in the electronic component problem, where susceptibility to various weapon effects demands very careful fabrication techniques. An education program will have to be established to teach these techniques to the piece-part manufacturer, and quality controls and screening procedures established to upgrade the reliability of each component. This same careful treatment must be applied in other areas as well. The launch control facility in which a misplaced crowbar shorted out a screen, carefully designed to keep out EMP, is a case in point.

There are some effects which have

not been simulated, and possibly never will be, either because the power required is not available or the large-scale effects cannot be satisfactorily reproduced. Response of systems to combined effects, likewise, is difficult to reproduce without full-scale testing. The most cogent argument for full-scale nuclear vulnerability testing, however, lies in the significant difference between nuclear and non-nuclear environments. Unless a great effort is made and much money spent, nuclear vulnerabilities in a system may never be discovered until it is too late. Corrosion, lightning, turbulence, and other non-nuclear environments are lived with on a daily basis, and the operational commands have experience in maintaining their systems in those environments. While the Nuclear Test Ban Treaty makes it more difficult to discover the nuclear vulnerability problems, the simulation program can still provide indispensible effects data.

A great deal remains to be done. To say that the job will ever be completed is to misunderstand the nature of the problem. The continuing objective of AFWL is to promote greater awareness and understanding among the critical organizations—laboratories, system program offices, and industry—of the problems of survivability/vulnerability, and the proper methods for solving them. In achieving this objective, we will be well on our way to more survivable weapon systems and a stronger defense posture.

SAMSO

(Continued from page 5)

vered to a pre-determined landing area like an aircraft; a manned space station to operate at near-synchronous orbit and perform a combination of missions; and a number of alternative methods and equipments for rescue of astronauts from space emergencies, such as explosions, meteroid penetrations, and fire.

Fundamental to advanced planning is the work of the SAMSO Technology Directorate, responsible for using the wide variety of resources available, both within and outside the Government, to identify and attack limiting technologies which prevent achievement of desired operational capabilities. In a broad and active program of exchange of information with Air Force laboratories and industry, the directorate also explores areas of new technology which might result in new and different capabilities.

It conducts extensive study and development work in survivability of missiles and space systems, and is responsible for certain advanced development programs designed to provide the technological building blocks for tomorrow's missile and space systems. Among typical present projects, for instance, is work on improvement of guidance accuracy, hardening of subsystems against nuclear effects, and development of new types of power systems for space vehicles.

The Directorate of Technology is also the agent for the DOD Space Experiments Support Program (SESP), performing integration, engineering and launch services for space experiments approved by DOD. This program provides a kind of "space pickup truck" service to orbit experiments originated outside of the Defense Establishment, but of interest to DOD. Experiments may originate with any organization whose work meets the requirements for DOD approval—the Office of Aerospace Research, National Aeronautics and Space Administration, Atomic Energy Commission, universities, aerospace industries. To date, there have been 7 SESP launches of 12 satellites incorporating 65 experiments. Additional experiments are planned for launch in the future.

The work of the directorate brings into clear focus one of the most vital areas of close interface and cooperation between SAMSO and industry—independent research and development. The directorate keeps in close, active touch with the independent research and development programs of industry, systematically identifying and assessing work which has potential for future missile and space developments. Participating in this DOD program are 114 contractors. More than 80 of them are presently doing work of particular interest to SAMSO.

Our program for evaluation of unsolicated proposals is another evidence of keen and continuing interest in the creative thinking of industry. Every unsolicated proposal submitted to SAMSO is carefully weighed, and a significant number of these—17 in FY 1968—are accepted and funded each year.

We are always keenly aware of the fact that ours is a mission which battles with unknowns. In addition to internal Air Force resources, we depend upon the research and development skills and resources of industry to supply much of the creative imagination essential to future strengthening of missile defense and expansion of space capabilities.

The progress of the last 15 years conclusively proves the validity of this approach. The Air Force/industry partnership has been productive beyond the most optimistic hope of the early 1950s. That working relationship has become SAMSO's most valuable single resource for this nation's future in space.

Portable Psy-War Audio-Visual Gear Army Goal

A three-man audio-visual system for disseminating psychological messages to remote areas is under study by the Army. Planned for audiences of from a few to groups of 400, the man-portable system, as seen by the Army Combat Developments Command (CDC), Fort Belvoir Va., would utilize the latest advancements in microminiaturization to permit field employment by small teams.

CDC sees the system consisting of compatible units, elements, modules and subassemblies using principles of unit construction or solid-state techniques. In addition, the system would required high-energy, long-life power sources, allowing increased transmission range and fidelity, while retaining compact size and weight. New techniques in closed circuit TV, long-range image projection, and daylight bright images are being considered by CDC.

The system is planned for use by psychological operations units, civil affairs units, special forces teams and advisory groups in all areas of the world. To meet this requirement, the system must also have airdrop capability.

Special training for the operators should be limited to a short orientation, with little technical skill required, and the system ideally would be compatible with contemporary Army audio-visual aids.

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Fuel Supplier for Worldwide U.S. Military Activities

Rear Admiral F. W. Martin Jr., SC, USN

The Defense Department's responsibility for procurement of fuel, lubricants and petroleum services to all U.S. military activities throughout the world, as well as for non-military government activities in the United States and its possessions, is assigned to the Defense Fuel Supply Center (DFSC). The center, located at Cameron Station, Alexandria, Va., is a field activity of the Defense Supply Agency (DSA).

Unlike other DSA supply centers, DFSC does not manage inventories nor budget for funds to pay for the goods and services it procures. First and foremost, DFSC is a procurement activity, with annual contract awards currently running near the $1.8 billion level. Secondly, DFSC is a coordinator of distribution for petroleum fuels which must be moved by ocean tanker—almost 180 million barrels in FY 1969.

Perhaps the best indicator of the magnitude of the task is the following fact: The entire economy of the United States, by far the world's largest consumer of petroleum products, could be sustained for a full month by the gallonage included in the annual DFSC petroleum buy.

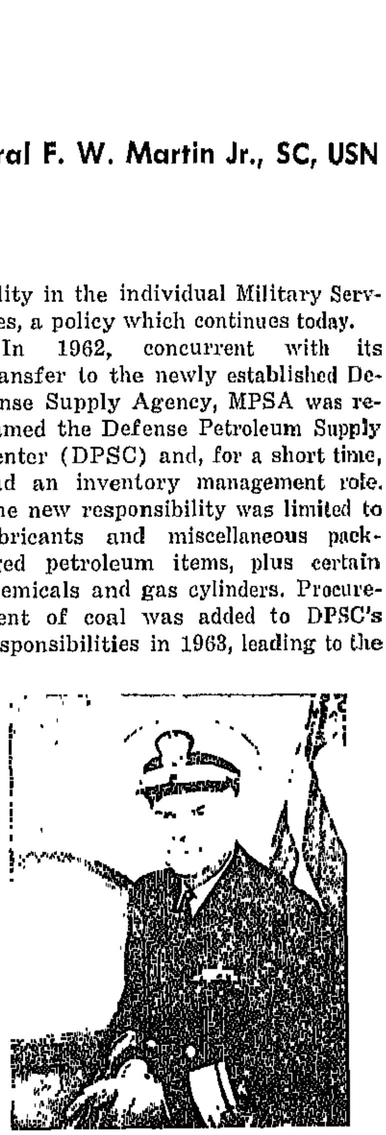
Development of Military Petroleum Management

It would seem, then, that the military importance of petroleum needs no emphasis. Yet this was not always so—and not too long at that. It was not until 1942, after Pearl Harbor, that the need for a degree of centralized control of military petroleum supply was recognized. Recognition of that need led to the creation of the Amy-Navy Petroleum Board (ANPB) as an agency of the Munitions Board to "Coordinate the supply and distribution of petroleum products to the U.S. Military and our allies."

ANPB, although not itself a procurement activity, did initiate the central coordination of ocean tanker distribution. It also pointed the way towards the eventual establishment of centralized petroleum procurement, which found its genesis in the National Defense Act of 1947, and the resultant creation in 1948 of the Armed Services Petroleum Procurement Agency (ASPPA) as a DOD activity. Thus, for the first time, common Army, Navy, Air Force and Marine Corps requirements were satisfied by consolidated procurement actions. ASPPA also assumed the ANPB mission of coordinating the worldwide ocean tanker distribution mission, and became the organizational grandparent of today's DFSC.

The next important evolutionary development of petroleum management occurred in 1956, when the need for greater centralization of logistic support led to the "single manager" concept. In effect, that concept handed to one Military Service full responsibility for the supply of an homogeneous group of common supply items for all the Services. ASPPA was reorganized and given an expanded mission, including functions in the areas of cataloging, standardization, procurement inspection, training and procurement of commercial storage, testing and refueling services. Renamed the Military Petroleum Supply Agency (MPSA), it became an activity under control of the Navy. At that time a decision was made to deviate from the basic single manager concept and retain petroleum inventory ownership and funding responsibility in the individual Military Services, a policy which continues today.

In 1962, concurrent with its transfer to the newly established Defense Supply Agency, MPSA was renamed the Defense Petroleum Supply Center (DPSC) and, for a short time, had an inventory management role. The new responsibility was limited to lubricants and miscellaneous packaged petroleum items, plus certain chemicals and gas cylinders. Procurement of coal was added to DPSC's responsibilities in 1963, leading to the



Rear Admiral F. W. Martin Jr., SC, USN, has been Commander of the Defense Fuel Supply Center of the Defense Supply Agency since November 1966. Prior to this command, he was Deputy Commander for Planning and Policy, Naval Supply Systems Command. Admiral Martin holds a B.A. degree from the University of Washington, and an M.B.A. from the Graduate School of Business, Stanford University.

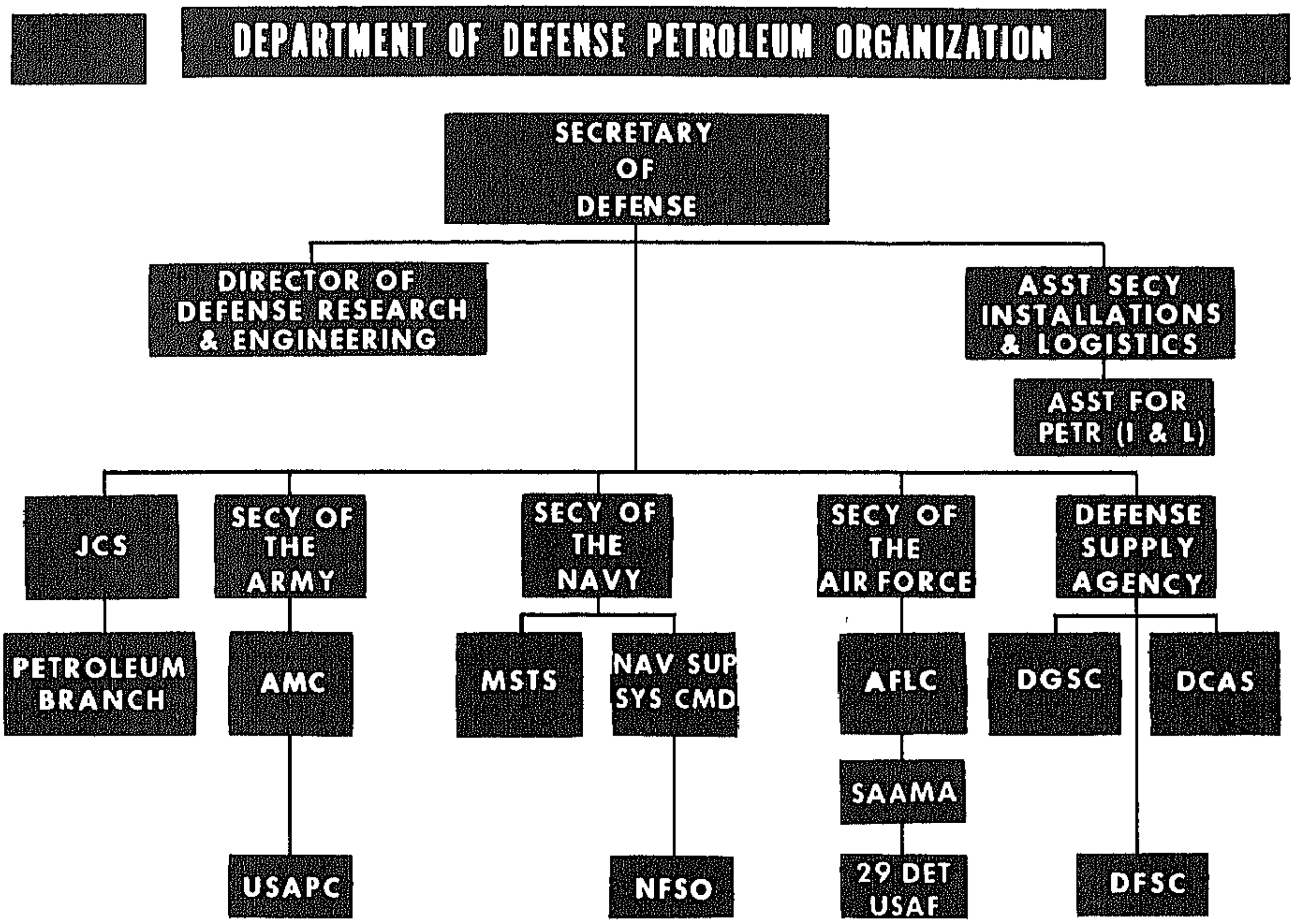


Figure 1.

ubstitution of "Fuel" for "Petroleum" in the center's name—thus, it became the Defense Fuel Supply Center. It was not long (early 1965) before it became apparent that the limited management functions could be handled more efficiently by a "conventional" supply center, rather than at DFSC with its primary orientation towards procurement and the distribution of bulk petroleum. The supply management function was transferred to the Defense General Supply Center, located at Richmond, Va., taking with it cataloging and standardization responsibilities.

Organization

Organizationally, DFSC is composed of five staff elements and three operational directorates, all of which report directly to the commander. The staff elements—counsel, planning and management, contract review, technical services, and small business—perform advisory and specialized functions for the commander, and support the operations directorates which do the real work—buying and moving the product. The center is authorized 16 military and 194 civilian personnel, and operates on an annual budget of about $2.25 million.

The worldwide military petroleum logistic organization is a complex of many elements. Figure 1 illustrates where DFSC fits into the overall DOD organization, and identifies other major elements involved in the petroleum logistic mission.

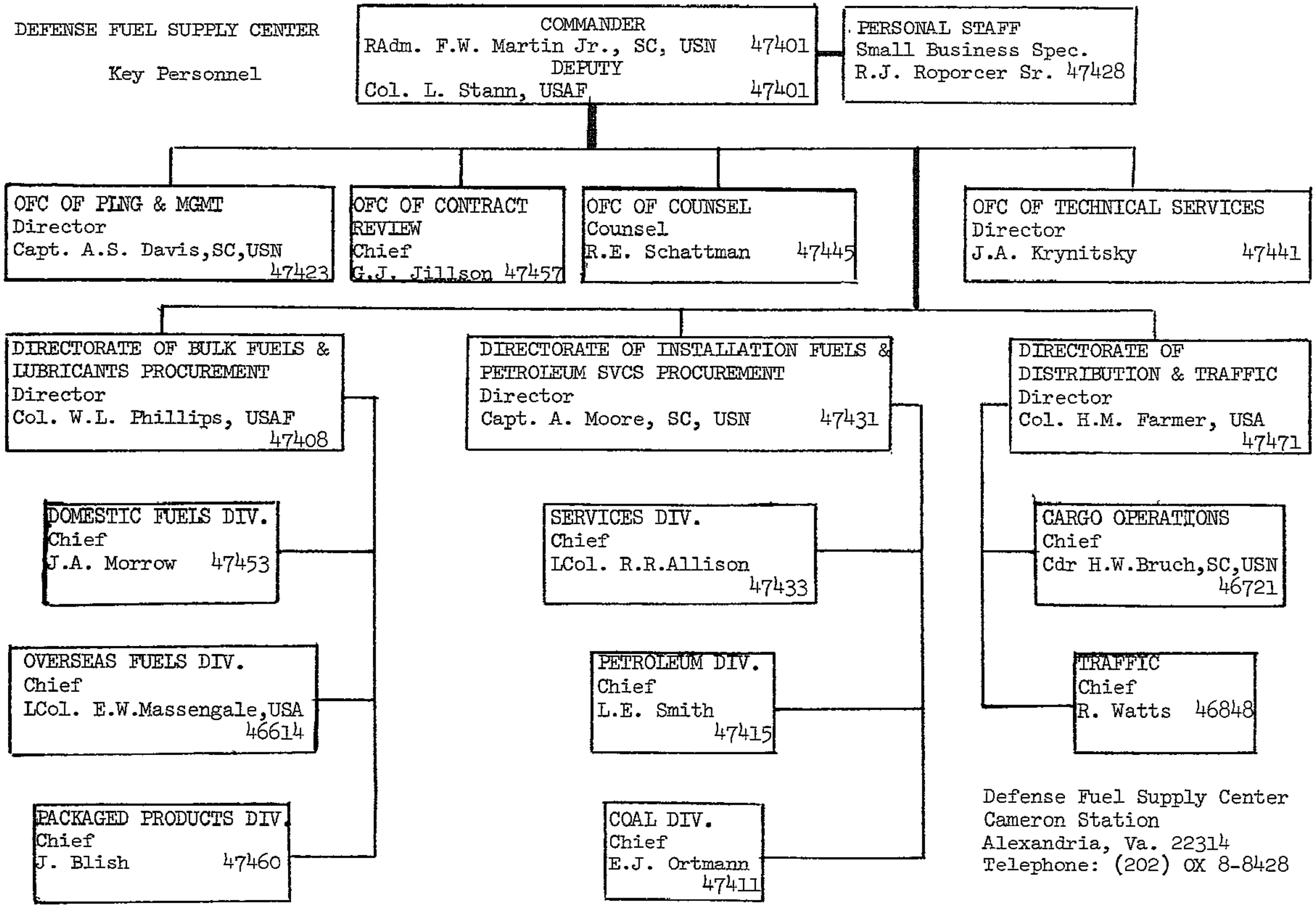
Procurement Mission

Fundamentally, DFSC's relations with other activities are built around the two principal missions already discussed—procurement and distribution. Looking first at procurement, requirements for petroleum fuels and coal are developed at the consuming level in each Service, and move upwards through consolidating levels to the inventory control points (ICPs). The ICPs, the Military Service petroleum inventory managers, collocated with DFSC at Cameron Station, submit their consolidated requirements to DFSC in accordance with published procurement program schedules. These schedules establish when procurement will occur for each product in each geographical area, as well as the delivery period which will be covered by the awards under each program. Selected civil activities submit their unconsolidated requirement direct to DFSC, also in accordance with the schedules.

Packaged petroleum procurement requirements, mostly lubricants and greases, come from the Defense General Supply Center (DGSC) for maintenance of depot inventories managed by that center. Other re-

DEFENSE FUEL SUPPLY CENTER

Key Personnel



Defense Fuel Supply Center
Cameron Station
Alexandria, Va. 22314
Telephone: (202) OX 8-8428

quirements for lubricants, which can be supplied to customers direct from commercial sources, bypass DGSC and come directly to DFSC from the consuming activities. Requirements for storage, refueling, and other services generally come from military ICPs.

The great majority of these requirements, consisting of bulk liquid petroleum products and packaged items for direct delivery to customers, are procured on an indefinite quantity basis. The customer (whether civil activity, individual military base, overseas command, or, in the case of the larger bulk requirements, the ICP) is, in fact, the buyer—the man who actually gives the contractor a funded delivery order for a specific quantity of an item or service under the terms of the appropriate DFSC contract. On the other hand, packaged lubricants for DGSC depot stock, and for most Services, are procured in fixed quantity, funded contracts for delivery in accordance with schedules included in the contracts—much as most non-petroleum supplies are procured by other DSA supply centers.

DFSC has the responsibility for worldwide procurement of fuel, including deliveries into some rather remote installations and sometimes under unusual circumstances. Each year contracts are awarded in over 90 countries or territories all over the world, close to 90 percent of all dollar awards are made on a competitive basis, over 45 percent of all awards result from use of the formal advertising process, and more than 23 percent of all procurement in the United States is given to small business.

Worldwide Distribution

While coal and lubricants are important elements in the DFSC mission, bulk liquid petroleum fuels constitute well over 90 percent of the total dollar value of the center's awards. Bulk fuels are vital commodities to the Armed Forces, and the worldwide distribution procedures require close coordination to ensure adequate supplies at all times. DFSC is assigned the responsibility for this coordination with the refineries, Military Sea Transportation Service (MSTS), and the military customers.

Bulk supplies in the United States which move overland by pipeline, rail, or highway are ordered direct from the refineries according to DFSC contracts, as needed. The same procedure is followed in overseas areas where DFSC contracts have been placed with local oil companies. However, bulk fuel requirements, which must be moved by ocean tanker, require a system of scheduling which will preclude any possibility of supply breakdown even with the long lead times involved.

The overseas unified commands, through the staff joint petroleum offices, consolidate the requirements of all Army, Navy, Air Force and Marine Corps forces in their command area, and submit them to DFSC monthly on a document called the "slate." The Military Service ICPs make up slates for tanker-supplied product in the United States, as well as supplying the funds to pay for the fuel. The Military Sea Transportation Service provides the tankers in the right size for each job at the time and place required. The tankers come from the MSTS fleet or, if necessary, are chartered.

The monthly slate, which DFSC receives from each of the five overseas unified commands and the three ICPs, lists requirements for each product over a five-month period, and shows how much is needed at specific locations at specific times. The contracts to provide these products have been previously awarded by DFSC. It is necessary to coordinate the activities of the refinery, the shipping terminal, the MSTS ships, and the receiving terminal. Approximately 80 to 85 ships load in an average month with more than 15 million barrels of fuel, and the loading ports are in such diverse locations as Texas, Pennsylvania, California, Venezuela, France, Japan, Saudi Arabia, England and Italy. The destinations are also worldwide.

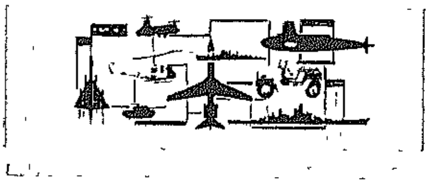
The scheduling is often complicated by having to load two or more products from different terminals and from having multiple discharge ports. Advanced planning is necessary as the destination can be as much as 14,000 miles and 37 days away. Extreme care must be taken to ensure that DFSC scheduling does not cause delays, as a single day demurrage on a tanker will cost from $4,000 to $12,000.

Specification Requirements

Inherent in any supply system is a need for assurance that the supplies meet specifications—that they will do the job they are intended to do. There are few areas where quality assurance is more important than it is in the procurement and delivery of petroleum. Faulty products, fuel or lubricants, can cause engine failure and possible loss of a multi-million dollar airplane and its human cargo; they can cause mechanical failure or excessive maintenance in ships' engines and boiler rooms; they can stop armored units in the field. Products must be inspected on delivery, and repeatedly throughout the distribution system, to ensure that they are and remain in compliance with specification requirements. Quality assurance representatives around the world do the job in accordance with DFSC-developed procedures. DFSC technical personnel also assist Military Service technicians in the field on day-to-day quality maintenance problems. Additionally, they play an important role in maintaining a broad base of supply by reviewing specifications to ensure that they are not so restrictive as to limit the number of refiners who will offer the items for sale.

Other functions performed by DFSC include the administration of the military's allocation for the import of petroleum under the Mandatory Oil Import Control Program, administration of the Defense Department's program to reduce the adverse international balance of payments insofar as it pertains to petroleum, and the coordination of petroleum industry training for civilian and military personnel of the Government. This latter function involves DFSC in a continuing cooperative effort with the American Petroleum Institute and member companies which sponsor semi-annual indoctrination courses for selected personnel, who will be concerned with petroleum in their daily work, and in fostering mutual understanding between government and industry personnel.

That is the story of the Defense Fuel Supply Center. It is a small organization with a very big job. The people who man DFSC know full well that, in the final analysis, they are part of a worldwide team of players from the Military Services, civilian government agencies and private industry. It is the cooperative, coordinated performance of the whole team that makes DFSC's success possible.



DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of August 1969.

DEFENSE SUPPLY AGENCY

4—B.V.D. Co., Inc., New York, N.Y. $1,250,-653. 3,290,160 men's crewneck white cotton undershirts. Mullins Textile Mills Co., Mullins, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0211

5—Choctaw Manufacturing Co., Inc., Silas, Ala. $1,205,809. 528,000 pairs of Navy enlisted men's white trousers. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0238.

8—Safety First Shoe Co., Inc., Nashville, Tenn. $3,855,054. 456,760 pairs of men's leather combat boots. Huntsville, Ala. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0266.

—J. H. Rutter Rex Manufacturing Co., New Orleans, La. $1,098,402. 492,040 pairs of Air Force men's cotton twill trousers Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0257.

—Dana Corp., Taylor, Mich. $6,076,031. 1,542,140 steel helmets. Trenton, Mich. Defense Personnel Support Center, Philadelphia, Pa DSA 100-70-C-0252.

11—Standard Oil Co. of Calif., San Francisco, Calif. $1,083,600. 200,000 barrels of marine diesel fuel oil for delivery to Barbers Point, Oahu, Hawaii. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-D-0234.

15—International Harvester Co., Melrose Park, Ill. $2,632,499. Tractors. Chicago, Ill. Defense Construction Supply Center, Columbus, Ohio. DSA 700-70-C-8054.

—U & W Industries, Inc., Selma, Ala. $1,-128,050. 1,128,400 men's cotton sateen shirts. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0322.

19—C. M. London Co., New York, N.Y. $1,117,-231. 1,190,000 linear yards of water repellent polyester and cotton poplin cloth, Army green. Chesnee, S.C., and Trion, Ga. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0365.

21—Tanenbaum Textiles Co., Inc., New York, N.Y. $1,204,842. 746,000 yards of wind-resistant oxford cotton cloth. Lewiston, Maine, and Clevedale, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0372.

—J. P. Stevens and Co., Inc., New York, N.Y. $1,197,630. 750,000 yards of wind-resistant oxford cotton cloth. Whitmore and Wallace, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0373.

27—West Point Pepperell, Inc., New York, N.Y. $1,437,885. 1,941,000 yards of cotton duck cloth. Anderson, S.C., Langdale, Ala., and Memphis, Tenn. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0331.

28—La Crosse Garment Manufacturing Co., La Crosse, Wis. $1,767,482. 138,132 mountain sleeping bags. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0395.

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company—Value—Material or Work to be Performed—Location of Work Performed (if other than company plant)—Contracting Agency—Contract Number.

DEPARTMENT OF THE ARMY

1—Dravo Corp., Bellevue, Wash. $13,318,001. Construction of the main dam and facilities for up-stream fish passage, and roads at the Wynoochee Dam, Wash. Army Engineer District, Seattle, Wash. DA-CW67-70-C-0005.

—Oman Construction Co., Inc., Nashville, Tenn., and Codell Construction Co., Inc., Winchester, Ky. $11,211,450. Construction of Stage II, Laurel Dam, Laurel and Whitley Counties, Ky. Army Engineer District, Nashville, Tenn. DA-CW62-70-C-0008.

—Philco Ford Corp, Newport Beach, Calif $2,700,000 (contract modification). Phase II of the Fair Measurement Program. Newport Beach and Palo Alto, Calif. Safeguard System Command, Huntsville, Ala DA-HC60-69-C-0085.

—Pacific Car and Foundry Co., North Renton, Wash. $3,045,500. M116A1 amphibious cargo carriers and XM733 full tracked amphibious assault vehicles. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-0079.

4—Donovan Construction Co., New Brighton, Minn. $2,247,200 (contract modification). Metal parts for 155mm high explosive projectiles. Twin Cities Army Ammunition Plant, New Brighton, Minn. Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-AA09-69-C-0036.

5—R. M. Wells, Quanah, Tex. $3,205,000. Construction of an addition to an existing hospital, Sheppard AFB, Tex. Army Engineer District, Albuquerque, N.M. DA-CA47-70-C-0010.

—White Motor Corp., Lansing, Mich. $5,133,-483 (contract modification). M602 series 2½ ton trucks. Project Manager, General Purpose Vehicles, Warren, Mich. DA-AE06-69-C-0003.

—Hughes Tool Co., Culver City, Calif. $1,-598,000. Disassemble, inspect and repair 47 crash-damaged OH-6A helicopters. El Segundo, Calif. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-A-0017.

—Guy H. James Construction Co., Oklahoma City, Okla. $1,751,031. Construction and associated work at the DeGray Dam and Reservoir Project, Caddo River, Ark. Army Engineer District, Vicksburg, Miss. DA-CW38-70-C-0030.

6—Pace Corp., Memphis, Tenn. $1,524,250 (contract modification). Ground illumination signals (white star cluster parachute). Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0384.

8—Logistics Management Institute, Washington, D.C. $1,300,000 (contract modification). 24 professional man-year effort in fact-finding analytical studies in logistics management. Defense Supply Service, Washington, D.C. SD-271.

11—The Army Aviation Systems Command, St. Louis, Mo., awarded the following contracts for maintenance support, modifications and crash/battle damage repairs for Army aircraft in South Vietnam:

Dynaelectron Corp., Fort Worth, Tex. $9,139,380. DA-23-204-AMC-04022(T).

Lear Siegler, Inc., Oklahoma City, Okla. $7,682,573. DA-23-204-AMC-04023(T).

Lockheed Aircraft Corp., Midwest City, Okla. $3,008,047. DA-23-204-AMC-04024 (T).

13—Sovereign Construction Co., Ltd., Fort Lee, N J. $15,830,000. Construction of two cadet barrack buildings, U.S. Military Academy, West Point, N.Y. Army Engineer District, New York, N.Y. DA-CA51-70-C-0014.

—Martin Marietta Corp., Orlando, Fla. $1,-493,800 (contract modification). System component test stations for the Pershing missile. Army Missile Command, Redstone Arsenal, Ala. DA-AH01-69-C-1534.

15—Robert E. McKee General Contractor, Inc., El Paso, Tex. $15,862,000. Construction of a 12-story general hospital. Army Engineer District, Albuquerque, N.M. DA-CA47-70-C-0011.

—Pace Corp., Memphis, Tenn. $8,827,000 (contract modification). Ground illumination signals. Memphis and Camden, Ark. Picatinny Arsenal, Dover, N.J. DA-AA21-69-C-0519.

—AVCO Corp., Stratford, Conn. $7,308,312 (contract modification) T53-L-13A gas turbine engines. Stratford and Charleston, S.C. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-C-1874.

—Motorola, Inc., Scottsdale, Ariz. $1,900,000. SM596 fuzes for 40mm shells. Harry Diamond Laboratories, Washington, D.C. DA-AG39-70-C-0156.

—Lasko Metal Products, Inc, West Chester, Pa $1,039,512 (contract modification). SUU-14A/A bomb dispensers. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0156.

—Sperry Rand Corp., Phoenix, Ariz. $1,-267,302. AN/ASN-43 gyro-magnetic compass sets Phoenix and Durham, N.C. Los Angeles Procurement Agency, Pasadena, Calif. DA-AG07-69-C-0436.

—Chris Berg, Inc., Seattle, Wash. $1,131,-958. Construction of NCO open mess building and necessary utilities, Fort Lewis, Wash. Army Engineer District, Seattle, Wash. DA-CA67-70-C-0001.

—Western Electric Co., New York, N.Y. $7,877,914. Continuation of training aids engineering for the Safeguard Ballistic Missile Defense System. Safeguard System Command, Huntsville, Ala. DA-HC60-69-C-0010.

18—Baldwin-Lima-Hamilton Corp., Philadelphia, Pa. $1,093,098. Design, manufacture, delivery and installation of a 98,000 horsepower hydraulic turbine, plus spare parts. Eddystone, Pa., and Laurel River Reservoir Project, Ky Army Engineer District, Nashville, Tenn DA-CW62-70-C-0012.

—Baltimore Contractors, Inc., Baltimore, Md. $6,594,000. Construction of a two-story laboratory, administration and medical building, Fort Detrick, Md. Army Engineer District, Baltimore, Md. DA-CA31-70-C-0008.

20—Bell Aerospace Corp., Fort Worth, Tex. $6,720,000. Crash-worthy fuel cell modification kits for UH-1 helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo DA-AJ01-69-A-0314.

22—Varo, Inc., Garland, Tex. $1,179,604. Two-year procurement contract for 40mm image intensifier assemblies. Army Electronics Command, Procurement Division, Fort Monmouth, N.J DA-AB07-69-C-0308.

—Weatherhead Co., Cleveland, Ohio. $3,-573,300. Metal parts for 105mm projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0010.

25—Hughes Tool Co., Culver City, Calif. $1,-660,131. Tail rotor hubs and blade assemblies for OH-6 helicopters. Army Aviation Systems Command, St Louis, Mo. DA-23-204-AMC-03697(T).

26—Chrysler Motors Corp., Warren, Mich. $2,307,338. Cargo trucks and ambulances.

Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-0106.

—Bell Aerospace Corp., Fort Worth, Tex. $2,005,091. Rotor hub assemblies for UH-1 helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

—Boeing Co., Morton, Pa. $1,455,651. Ground support equipment for CH-47 helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-A-0005.

—J. I. Case Co., Racine, Wis. $1,065,534 (contract modification). Loaders. Racine, Terre Haute, Ind., and Burlington, Iowa. Army Mobility Equipment Command, St. Louis, Mo DA-AK01-69-C-A817.

27—LTV Aerospace Corp., Honolulu, Hawaii $11,135,000 (contract modification). Operation, maintenance and development of Kwajalein Missile Range technical facilities for 12 months. Kwajalein, Marshall Islands. Safeguard System Command, Huntsville, Ala. DA-HC60-69-C-0003.

—Electro-Optical Systems, Inc., Pasadena, Calif. $1,899,630. AN/TVS-4 night vision sights. Pomona, Calif. Army Electronics Command, Fort Monmouth, N J. DA-AB07-68-C-0190.

29—The Army Ammunition Procurement and Supply Agency, Joliet, Ill., issued the following contracts:

Batesville Manufacturing Co., Batesville, Ark. $8,098,200. Metal parts for M901E2 bomb nose fuzes. DA-AA09-70-C-0015.

Raytheon Co., Lexington, Mass. $6,975,150 Metal parts for M905 bomb tail fuzes. DA-AA09-70-C-0017.

Eureka Williams Corp., Bloomington, Ill. $4,367,436. Metal parts for M904-E2 bomb nose fuzes. DA-AA09-70-C-0016.

Stewart-Warner Corp., Indianapolis, Ind. Metal parts for M148 booster adapters less sleeves. DA-AA09-70-C-0030.

U.S. Components Corp., Bloomfield, Mich. $1,102,500 Metal parts for M148 booster adapters less sleeves. DA-AA09-70-C-0031.

—The Army Tank Automotive Command, Warren, Mich., issued the following contract modifications:

White Motor Corp., Lansing, Mich. $2,018,320. Engineering services for 5-ton trucks. DA-AE07-67-C-5043.

Ford Motor Co., Dearborn, Mich. $1,990,500 Engineering support for 5-ton trucks. DA-AE07-68-C-0445.

AVCO Corp., Stratford, Conn. $1,464,000. Design, develop, test and fabricate AGT-1500 turbine engines. DA-AE07-70-C-0082.

—Guy James Construction Co., Oklahoma City, Okla. $6,698,692. Construction of a dam and associated work, two miles south of Farmer, Ky. Army Engineer District, Louisville, Ky DA-CW27-70-C-0013.

—Hensel Phelps Construction Co., Greeley, Colo., and Penner Construction Co., Denver, Colo. $3,097,000. Aerospace Data Processing Facility, Buckley Air National Guard Base, Colo Army Engineer District, Omaha, Neb. DA-CA45-70-C-0015.

—Raytheon Co., Andover, Mass. $2,000,008 (contract modification). Engineering services for the Improved Hawk missile system. Andover and Bedford, Mass., and White Sands Missile Range, N.M. Army Missile Command, Redstone Arsenal, Ala. DA-AH01-69-C-0009.

—Bethlehem Steel Corp., Bethlehem, Pa. $1,959,966. Gun tube forgings for 175mm guns. Watervliet Arsenal, Watervliet, N.Y. DA-AF07-69-C-0257.

—Raytheon Co., Waltham, Mass $1,059,331. Magnetron tubes for the Nike missile system. Army Missile Command, Redstone Arsenal, Ala. DA-AH01-70-C-0247.

—Bell Aerospace Corp., Fort Worth, Tex. $9,330,000. UH-1N helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-70-C-0205.

—Honeywell, Inc., Hopkins, Minn. $1,497,500. Phase I component development of a three phase program covering design and development of an Area Denial Artillery Munitions. Picatinny Arsenal, Dover, N.J. DA-AA21-70-C-0096.

—Hughes Aircraft Co., Culver City, Calif. $9,185,848. Engineering services and support of the TOW missile. Culver City and Tucson, Ariz. Army Missile Command, Redstone Arsenal, Huntsville, Ala. DA-AH01-70-C-02909.

DEPARTMENT OF THE NAVY

1—General Electric Co., Cincinnati, Ohio. $1,810,000. Overhaul kits for maintenance of J79-GE-8 engines. Naval Aviation Supply Office, Philadelphia, Pa. F34601-69-A-1029-GB56.

—North American Rockwell Corp., Anaheim, Calif. $1,216,000. Operation and maintenance of Mark II Ships Inertial Navigation System in-house equipment, FY 1970. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5010.

4—Hughes Aircraft Co., Culver City, Calif. $13,400,000 (contract modification). FY 1970 funding for the Phoenix missile system. Culver City, Canoga Park and El Segundo, Calif. Naval Air Systems Command, Washington, D.C. N00019-67-C-0240

—Bendix Corp., Baltimore, Md. $6,846,498 (contract modification). Increase in limitation of authorization for AN/APX-72 transmitters and associated equipment for the Army. Naval Air Systems Command, Washington, D.C. NOw 66-0037.

—Sparton Corp., Jackson, Mich. $5,589,373. AN/SSQ-47B sonobuoys. DeLeon Springs, Fla Naval Air Systems Command, Washington, D C. N00019-70-C-0055.

—Uniflite Corp., Bellingham, Wash. $1,089,489. Construction of twenty-three 31-foot river patrol boats (PBR). Naval Ship Systems Command, Washington, D.C. N00024-70-C-0211.

5—United Aircraft Corp., East Hartford, Conn. $3,536,640 (contract modification). Design and development of the J-52-P-408 engine. Naval Air Systems Command, Washington, D.C. N00019-69-C-0299.

—Whittaker Corp., Saugus, Calif. $1,961,232. Aircraft parachute flares, Mk 24 Mod 4. Naval Ships Parts Control Center, Mechanicsburg, Pa. N000104-69-C-0154 P009.

—Fulghum and Hinman, Inc., Pensacola, Fla. $2,400,000. Construction of a consolidated plating facility, Naval Air Rework Facility, Pensacola. Naval Facilities Engineering Command, Washington, D.C. N62467-67-C-0730.

6—McDonnell Douglas Corp., St. Louis, Mo. $11,100,000 (contract modification). Long lead time effort for Air Force RF-4E aircraft. Naval Air Systems Command, Washington, D.C. N00019-68-C-0495

—Kaman Aircraft Corp., Bloomfield, Conn. $4,739,902. Conversion of UH-2A/B helicopters to C configuration. Naval Air Systems Command, Washington, D.C. N00019-70-C-0051.

—Aero Corp., Lake City, Fla. $2,766,224 (contract modification). Progressive aircraft rework on P-2 series aircraft. Naval Air Systems Command, Washington, D.C. N00019-69-C-0186.

—General Dynamics Corp., Pomona, Calif. $1,655,295 (contract modification). Research and development on the Standard ARM missile. Naval Air Systems Command, Washington, D.C. N00019-68-C-0400.

7—Lockheed Missile and Space Co., Sunnyvale, Calif. $2,612,553. Engineering services for Polaris reentry systems. N00030-70-C-0050. $3,750,000. Repair of Polaris equipment. N00030-70-C-0057. Naval Strategic Systems Project Office, Washington, D.C.

8—General Dynamics Corp., Pomona, Calif. $2,062,130. Engineering services for the advanced development model of a close-in weapon control system. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-4235.

—James E. Cox Construction Inc., Charlotte, N.C. Construction of aircraft maintenance shops, Marine Corps Air Station, Cherry Point, N.C. Naval Facilities Engineering Command, Washington, D.C. N62470-68-C-0974.

11—Grumman Aerospace Corp., Bethpage, N.Y. $107,600,000 (contract modification). Incremental funding for F-14A weapons systems. Naval Air Systems Command, Washington, D.C. N00019-69-C-0422.

—Spartan Corp., Jackson, Mich. $3,828,092 (contract modification). AN/SSQ-41A sonobuoys. DeLeon Springs, Fla., and Jackson. Naval Air Systems Command, Washington, D.C. N00019-69-C-0495.

—FMC Corp., Minneapolis, Minn. $3,111,375. Component parts for 5 inch 54 caliber gun mounts. Naval Ordnance Station, Louisville, Ky. N00197-70-C-0065.

—Sperry Rand Corp., Long Island, N.Y. $2,902,000. Engineering services for Ships Inertial Navigation Systems during Poseidon conversion of seven nuclear powered fleet ballistic submarines (SSBN). Newport News, Va., Groton, Conn., Vallejo, Calif., Bremerton, Wash., and Portsmouth, N.H. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5372 P001.

—Bethlehem Steel Corp., Terminal Island, Calif. $1,694,201. Regular overhaul of the USS Passumpsic (AO-107). Supervisor of Shipbuilding, Conversion and Repair, Eleventh Naval District, Long Beach, Calif. N62791-70-B-0002.

12—Raytheon Co., Sudbury, Mass. $20,000,000. Poseidon guidance system electronics assembly requirements. Waltham, Mass. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0005.

—Interstate Electronics Corp., Anaheim, Calif $2,987,000. Poseidon missile test instrumentation. N00030-69-C-0123 PZ01. $1,876,000. Poseidon test and evaluation equipment. N00030-70-C-0084. Naval Strategic Systems Project Office, Washington, D.C.

—McDonnell Douglas Corp., St. Louis Mo. $4,800,000 (contract modification). Long lead time effort for F-4J aircraft. Naval Air Systems Command, Washington, D.C. N00019-68-C-0495.

—PRD Electronics, Inc., Jericho, N.Y. $2,096,100 (contract modification). VAST (Versatile Avionics Shop Test) building blocks and data transfer units. Naval Air Systems Command, Washington, D.C. N00019-68-C-0449.

—Thiokol Chemical Corp., Elkton, Md. $2,116,938 (contract modification). Pilot production of rocket motors for the ZAP missile. Naval Ordnance Laboratory, White Oak, Md. N60921-68-C-0168 P013.

13—General Electric Co., Schenectady, N.Y. $28,872,000. Nuclear propulsion research and development. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5027.

—General Dynamics Corp., Quincy, Mass. $1,491,370. Design work for nuclear propulsion plants. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5033.

15—Honeywell, Inc., Hopkins, Minn. $2,612,291. Manufacture of complete sets of low-speed fuel air explosive (FAE) components, less dispenser and bomb fusing. Naval Purchasing Office, Los Angeles, Calif. N00123-69-C-0281.

—Texas Instruments, Inc., Dallas, Tex. $1,396,924. Spare parts for forward looking radar system (APQ-126) for A-7E aircraft. Aviation Supply Office, Philadelphia, Pa. N00383-69-A-1801-0085.

18—Bendix Corp., Teterboro, N.J. $4,000,000. Inertial components for Poseidon missiles. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0063.

19—Aerojet-General Corp., Sacramento, Calif. $14,229,855. Increased level of effort and performance on FY 1970 Mk 56 mine program. Naval Ordnance Systems Command, Washington, D.C. N00017-68-C-1201.

—General Motors Corp., Goleta, Calif. $1,000,000. Warhead and exploder design for Mk 48 Mod. 1 torpedoes. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-1412.

—William F. Flingensmith, Inc., Rockville, Md. $1,119,700. Construction of an electrical evaluation facility, Naval Air Test Center, Patuxent River, Md. Naval Facilities Engineering Command, Washington, D.C. N62477-68-C-0900.

20—PRD Electronics, Inc., Jericho, N.Y. $2,314,965 (contract modification). Versatile

Avionics Shop Test (VAST) building blocks and data transfer units. Naval Air Systems Command, Washington, D.C. N00019-68-C-0449.

—Sanders Associates, Inc., Nashua, N.H. $1,970,098 (contract modification) Sonobuoys. Naval Air Systems Command, Washington, D.C. N00019-69-C-0397.

21—General Electric Co., Schenectady, N.Y. $12,275,000. Design and furnishing of nuclear propulsion components. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5154.

—Westinghouse Electric Corp., Washington, D.C. $2,423,018. Gas generators for Poseidon launchers. Sunnyvale, Calif. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0083.

—E. E. Black, Ltd., Honolulu, Hawaii. $1,141,000. Design and construction of barracks, Fleet Operations Control Center, Kunia, Hawaii. Naval Facilities Engineering Command, Washington, D.C. N62471-69-C-0508.

22—Westinghouse Electric Corp., Pittsburgh, Pa. $40,205,265 (contract modification). Design and furnish nuclear propulsion components. N00024-67-C-5058 Mod 14. $27,713,710. Nuclear propulsion research and development. West Mifflin Borough, Pa. N00024-70-C-5028. $2,456,612. Four Air Search Acquisition Radars and service test models. Friendship International Airport, Baltimore, Md. N00024-70-C-1035.

—Hahn and Clay Machine and Boiler Works, Houston, Tex. $2,337,762. Construction of a pressure chamber, Deep Ocean Engineering Pressure Chambers, Naval Ship Research and Development Laboratory, Panama City, Fla. Naval Facilities Engineering Command, Washington, D.C. N62467-69-C-0071.

25—United Aircraft Corp., East Hartford, Conn. $1,800,000 (contract modification). Production of YTF30-P-412 engines, related publications and ground support. Naval Air Systems Command, Washington, D.C. N00019-69-C-0614.

26—Honeywell Inc., St. Petersburg, Fla. $3,656,901. Poseidon inertial components. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0064.

—Westinghouse Electric Corp., Washington, D.C. $2,351,110. Poseidon launcher trainers. Sunnyvale, Calif. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0192.

27—G. L. Cory, Inc., San Diego, Calif. $6,372,014. Construction of an aircraft surface treatment shop, Naval Air Station, North Island, Calif. Naval Facilities Engineering Command, Washington, D.C. N62473-68-C-0153.

—Frequency Engineering Laboratories, Farmingdale, N.J. $1,180,000. Classified electronics equipment. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1432.

28—Singer-General Precision, Inc., Little Falls, N.J. $1,242,920. Components for AN/ASN-41 navigational sets Naval Aviation Supply Office, Philadelphia, Pa. N00383-70-C-0414.

—Curtiss Wright Corp., Wood-Ridge, N.J. $1,136,251. Spare parts for R1820 engines used on C-1A, EC-1A, E-1A, E-1B and S-2A series aircraft. Naval Aviation Supply Office, Philadelphia, Pa. F41608-69-A-0057.

29—Lockheed Missile and Space Co., Sunnyvale, Calif. $18,000,000. Poseidon missile production Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0092.

—General Electric Co., West Lynn, Mass. $15,900,000 (contract modification). Engineering development of TF-34 turbofan engines for the S-3A aircraft. Naval Air Systems Command, Washington, D.C. N00019-68-C-0443.

—S and S Contractors, Inc., Redmond, Wash. $1,591,066. Construction of 100 units of family housing, Naval Air Station, Whidbey Island, Wash. Naval Facilities Engineering Command, Washington, D.C. N62476-70-C-0029.

—Sperry Rand Corp., St. Paul, Minn $1,350,000. Production of digital computer Mk 152 Mods 0, 1 and 2, and associated ancillary equipment for modernization of Tartar and Talos fire control systems (Mk 74 and 77). Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2326.

DEPARTMENT OF THE AIR FORCE

1—Lockheed-Georgia Corp., Marietta, Ga. $80,000,000. Production of C-5A aircraft (Run A). Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33-(657)-15033

—United Aircraft Corp., East Hartford, Conn. $1,272,870. Production of components applicable to J-57 aircraft engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. N383-69000A.

4—Westinghouse Electric Corp., Baltimore, Md. $1,183,803. Spare parts and data applicable to F-4 aircraft radar sets. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F34601-69-A-0034.

—Aerodex, Inc., Miami, Fla. $1,576,745 Overhaul of T56 engines for C-130 aircraft. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F34601-69-D-3989.

—Kollsman Instrument Corp., Elmhurst, N.Y. $1,028,144. Procurement of aerospace ground equipment for AAU-19A aircraft navigational aids. Aeronautical Systems Division, AFSC, Wright-Patterson, AFB, Ohio. AF 33(657)-16524.

—Bendix Corp., Baltimore, Md. $2,330,900. Engineering and logistics services to provide system functional analysis, technical support and computer programming for the AN/FPS-85 phased array radar Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-69-D-0240.

—Sperry Rand Corp., Salt Lake City, Utah. $1,100,000. Procurement of long lead time items for aircraft drones (QU-22B). Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0172.

—Hughes Aircraft Co., Fullerton, Calif $1,393,000. Development of radar equipment in support of the Airborne Warning and Control System. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-69-C-0054.

5—Singer-General Precision, Inc., San Marcos, Calif. $1,893,885. Electronic components for C-130 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB Okla. F04606-69-A-0134-SD15.

—General Electric Co., Utica, N.Y. $1,530,000. Electronic countermeasure (ECM) canisters for aircraft, spare parts and aerospace ground equipment, and engineering services and data. Aeronautical Systems Division, AFSC, Wright-Patterson, AFB, Ohio. F33657-70-C-0101.

—Jet Power, Inc., Miami, Fla. $1,677,990. Estimated requirements for the overhaul, repair and modification of gas turbine engines for FY 1970. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-70-D-0320.

6—Boeing Co., Wichita, Kans. $1,645,000. Depot level modification to B-52 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-68-C-4053 P013.

—Hallicrafters Co., Rolling Meadows, Ill. $1,443,000. Aerospace ground equipment for aircraft electronics systems (AN/AAQ-4). Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0470-0002.

—Wyman-Gordon Co., North Grafton, Mass. $2,000,000. Rehabilitation of Bldg. 31, Air Force Plant No. 63, Worcester, Mass. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0147 P001.

—McDonnell Douglas Corp., Long Beach, Calif. $1,400,000. Logistics support for the C-9A aircraft. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-68-C-0001 P013.

—Lockheed Aircraft Corp., Sunnyvale, Calif. $9,000,000. Advance data system for Satellite Control Facility (SCF). Headquarters, Air Force Satellite Control Facility, Los Angeles AFS, Calif. F04695-67-C-0176 P031.

—General Electric Co., Philadelphia, Pa. $2,100,000 Research and development on the Mk 12 reentry vehicle. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF 04(694)-975.

7—Boeing Co., Seattle, Wash. $5,857,076. Phase II power/alterations program for Minuteman Wing V. Cheyenne, Wyo. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0142.

8—General Electric Co., West Lynn, Mass. $2,355,000 Production of J-85 turbojet engines for F-5A aircraft Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0008-P016.

—General Electric Co., Philadelphia, Pa. $3,400,000. Research and development of the Mk 12 reentry system. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF04 (694)-731

11—Itek Corp., Palo Alto, Calif. $2,628,900. Production of radar receiving equipment for A-7D and F-4E aircraft Sunnyvale, Calif. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-70-C-3334.

—Lockheed Aircraft Corp., Marietta, Ga. $4,591,211 Procurement of technical data and spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF33(657)-15053 P00D 300

—AVCO Corp., Stratford, Conn. $2,000,000. Work on the Mk 11C reentry vehicle. Space and Missile Systems Organization, Los Angeles, Calif. AF04-694-971.

12—Hercules, Inc., Wilmington, Del. $5,155,900. Production of third stage rocket motors for Minuteman II missiles, plus related data Magna, Utah. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-0022.

—Air Products and Chemicals, Inc., Allentown, Pa. $1,812,900. Procurement of liquid oxygen and nitrogen in support of missile and space program testing. Santa Susana, Calif San Antonio Air Materiel Area, AFLC, Kelley AFB, Tex. F41608 70-D-0284.

13—Curtiss-Wright Corp., Wood-Ridge, N.J. $3,052,901. Production of spare parts for aircraft engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608 69-A-0057

—TRW, Inc., Redondo Beach, Calif. $1,618,400. Research and development, fabrication, launch and orbital support for the VELA satellite program Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04695-67-C-0007.

14—Aerojet General Corp., Sacramento, Calif. $1,207,000. Pre-production effort to support FY 1970 requirements for Stage II Minuteman II motors. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0138.

15—Hughes Aircraft Co., Fullerton, Calif. $1,610,000. Development of a sensor reporting post, including computer program and related services. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-69-C-0120.

—North American Rockwell Corp., Tulsa, Okla. $2,431,000. Inspection and repair of Hound Dog air/ground missiles for B-52 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-68-C-0082.

—Boeing Co., Seattle, Wash. $2,075,000. Increment in support of the Safeguard system target test program. Space and Missile Systems Organization, AFSC, Los Angeles, Calif F04701-68-C-0199.

18—LTV Electrosystems, Inc., Greenville, Tex. $5,263,354. Inspection and repair as necessary of RF-101 aircraft. Greenville, S.C. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-2330.

19—TRW, Inc., Redondo Beach, Calif. $25,646,910 (change order to previously awarded contract). Design of satellites and dispensers for the Defense Satellite Communications System. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0091.

20—Sylvania Electronic Systems, Inc., Waltham, Mass. $2,888,800. Services and supplies in support of the Minuteman ground electronics system. Space and Missile Systems Organization, AFSC, Los Angeles, Calif F04701-69-C-0229.

—The Boeing Co., Seattle, Wash. $1,037,500. Installation and check-out of UHF antennas and radios, and refurbishment of launch facilities at Minuteman Wing

VI, Grand Forks AFB, N.D. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0160.

21—RCA, Moorestown, N.J. $1,600,000. Services and material for development, installation and test of equipment to provide pulse compression capability for the AN/FPS-92 radar set. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-69-C-0897.

22—Service Technology Corp., Dallas, Tex. $1,284,000. Increment for changes to conversion of range telemetry systems. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-C-0195.

25—Lockheed-Georgia Co., Marietta, Ga. $18,337,904. Spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta Ga. AF33(657)-15053.

—Boeing Co., Wichita, Kan. $2,920,000. Development of an electro-optical viewing system for the B-52 program. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-2487.

—Lockheed-Georgia Co., Marietta, Ga. $2,770,350. Development, activation and operation of a ground data processing system. 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33600-70-C-0201.

—Kollsman Instrument Corp., Elmhurst, N.Y. $1,150,136. Production of pressure-temperature test sets. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-69-D-9020.

26—Texas Instruments, Inc., Dallas, Tex. $2,170,000. Production of airborne radar, spare parts and related aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1299.

27—Honeywell, Inc. Hopkins, Minn. $10,000,000. Production of BLU 54/B munitions and canisters. St. Louis Park, Minn. Armament Development Test Center, AFSC, Eglin AFB, Fla. F08635-70-C-0001.

—Texas Instruments, Inc., Dallas, Tex. $1,250,000. Engineering effort to test and evaluate the KMU-35 1B guided bomb kit. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1206.

29—Curtiss-Wright Corp., Wood-Ridge, N.J. $5,403,516. Production of spare parts for J-65 aircraft engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-69-A-0057.

—Aerodex, Inc., Miami, Fla. $1,447,967. Overhaul of R4360-59B/63A series aircraft engines. San Antonio Air Materiel Area, Kelly AFB, Tex. F41608-69-D-0245.

—AVCO Corp., Stratford, Conn. $2,400,000. Fabrication and testing of Mark 11C Minuteman re-entry vehicles. Space and Missiles Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0242.

—General Electric Co., Philadelphia, Pa. $1,374,000. Research and development of Mark 12 re-entry vehicle. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF04(694)-473.

—General Electric Co., Philadelphia, Pa. $7,342,000. Production of Mark 12 re-entry system. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0178-P022.

—Aerojet-General Corp., Sacramento, Calif. $3,607,000. Production of stage II motors for Minuteman III. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0138.

Transfer of CIFE

The Office of the Central Index File, Europe (CIFE) has been transferred from the U. S. Mission to the North Atlantic Treaty Organization, and is now under the operational control of the Office of Industrial Security, Defense Supply Agency, Cameron Station, Alexandria, Va.

CIFE is staffed by two industrial security specialists and is located in Brussels, Belgium.

DSA Reports on FY 1969 Activities

The Defense Supply Agency (DSA) procured $5.2 billion of goods and services for the Armed Forces in FY 1969, slightly less than the $5.4 billion total for FY 1968. The gross number of supply requisitions received for DSA-stocked items totaled 20.3 million in FY 1969, an increase over the 19.7 million processed during the previous fiscal year.

DSA, with headquarters at Cameron Station in Alexandria, Va., furnishes supplies and services through a nationwide organization of supply and service centers and depots. It purchases and distributes to the Military Services food, clothing, electronic parts, fuel and petroleum products, medical, chemical, industrial, construction and general supplies. It also performs common services for the Defense Department, such as cataloging, surplus property sales, and the furnishing of research documents. In addition, the full range of DSA-managed material support is furnished to various Federal civil agencies, such as the Coast Guard and the National Aeronautics and Space Administration (NASA).

During FY 1969, DSA assumed responsibility for providing selected packaged petroleum items to all Federal civil agencies and is gradually assuming support of bulk fuel items for these agencies. In September 1969, DSA was given responsibility for supplying all Federal civil agencies with common electronic items.

Along with its procurement responsibilities, the agency provides uniform administration of contracts for supplies and services to the Military Departments, DSA, NASA, and other Federal agencies. At the end of FY 1969, approximately 238,000 prime contracts, valued at $54 billion, were under administration by the Defense Contract Administration Services (DCAS), a major component of the agency. Over $16 billion was paid out by the 11 DCAS regions, which processed 1.8 million contractor invoices.

On a system-wide basis, overall handling of supplies in FY 1969 dropped slightly in volume. The 2,179,000 short tons shipped by DSA compared with 2,317,800 shipped a year earlier. In the same period, DSA received 2,070,000 tons, while 2,081,000 short tons were received the previous year.

The total number of items which DSA centrally manages rose from 1.77 million in FY 1968 to 1.82 million in FY 1969. Customers for these items are the Army, Navy, Air Force, Marine Corps, and civilian agencies of the Government. DSA supply effectiveness, measured by the percentage of requisitions for stocked items filled from on-hand stocks, averaged over 90 percent during FY 1969.

Procurement Totals of Defense Supply Agency Centers

	FY 1968	FY 1969
	(Millions of dollars)	
Defense Construction Supply Center Columbus, Ohio 43215	$ 555.4	$ 608.2
Defense Electronics Supply Center Dayton, Ohio 45401	235.6	198.3
Defense Fuel Supply Center Alexandria, Va. 22314	1,768.2	1,660.0
Defense General Supply Center Richmond, Va. 23219	485.9	511.5
Defense Industrial Supply Center Philadelphia, Pa. 19111	226.0	284.3
Defense Personnel Support Center Philadelphia, Pa. 19101		
Clothing	593.7	677.1
Medical	205.5	203.7
Subsistence	1,185.6	1,188.6

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CDC Guides Army Computer Development

As the use of automation increases in the Army, the role of the Directorate of Automatic Data Processing and Management Information Systems (ADP/MIS) also increases. The directorate, part of the Army Combat Developments Command (CDC), Fort Belvoir, Va., has recently been given the job of preparing requirements for, and monitoring of, 15 major automatic data processing (ADP) programs.

The directorate is also responsible for development of combat and combat support automation systems. It aids in the preparation of system automation design, and, with other CDC directorates, provides guidance and review to ensure automation programs are compatible with present doctrine.

The idea for an ADP program may come from any element in the Army. A feasibility study is then conducted and, if the nomination passes, a general functional system requirement is prepared for the Department of the Army. Approval by the Department of the Army leads to the development of a detailed functional system requirement.

This detailed paper is an in-depth description of the function to be computerized. From this, the Computer Systems Command then develops the actual hard- and software—the computer system and the programming.

Throughout, CDC provides recommendations and user guidance to ensure that the system meets objectives, and that it will accomplish its functional requirements in the tactical environment.

Major ADP programs involving CDC include:

- CS3. A mobile computerized system for logistical and administrative procedures.
- TACFIRE. The application of ADP techniques to artillery in the field, including fire control, target intelligence and meteorology.
- TOS. The automation of intelligence and other information to aid the field commander in making operational decisions.

Directing ADP/MIS operations is Colonel Charles T. Caprino.

New Ceilometer Developed for USAF Combat Weathermen

Combat weathermen will have a more accurate method of determining cloud heights with a new ceilometer developed by AFSC's Electronic Systems Division, L. G. Hanscom Field, Mass. The ceilometer will be produced by the General Time Corp., Wheeling, Ill., for use by the Air Weather Service.

Compact and rugged, the ceilometer is easily transported and well suited to field use, with potential for paradropping into combat areas. Consisting basically of two units, a projector and a detector, the total weight of the device is 55 pounds. The ceilometer can be set up and used by a two-man crew.

In operation, the projector unit produces a modulated light beam which is directed upward. The light-sensitive detector, located 400 feet from the projector, picks up light signals reflected off the cloud base and relays them back to the projector unit. By reading the strongest beam, the operator can then translate the reading into cloud heights using simple geometry. The ceilometer is effective for cloud heights from 50 to 3,000 feet.

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DEFENSE INDUSTRY BULLETIN

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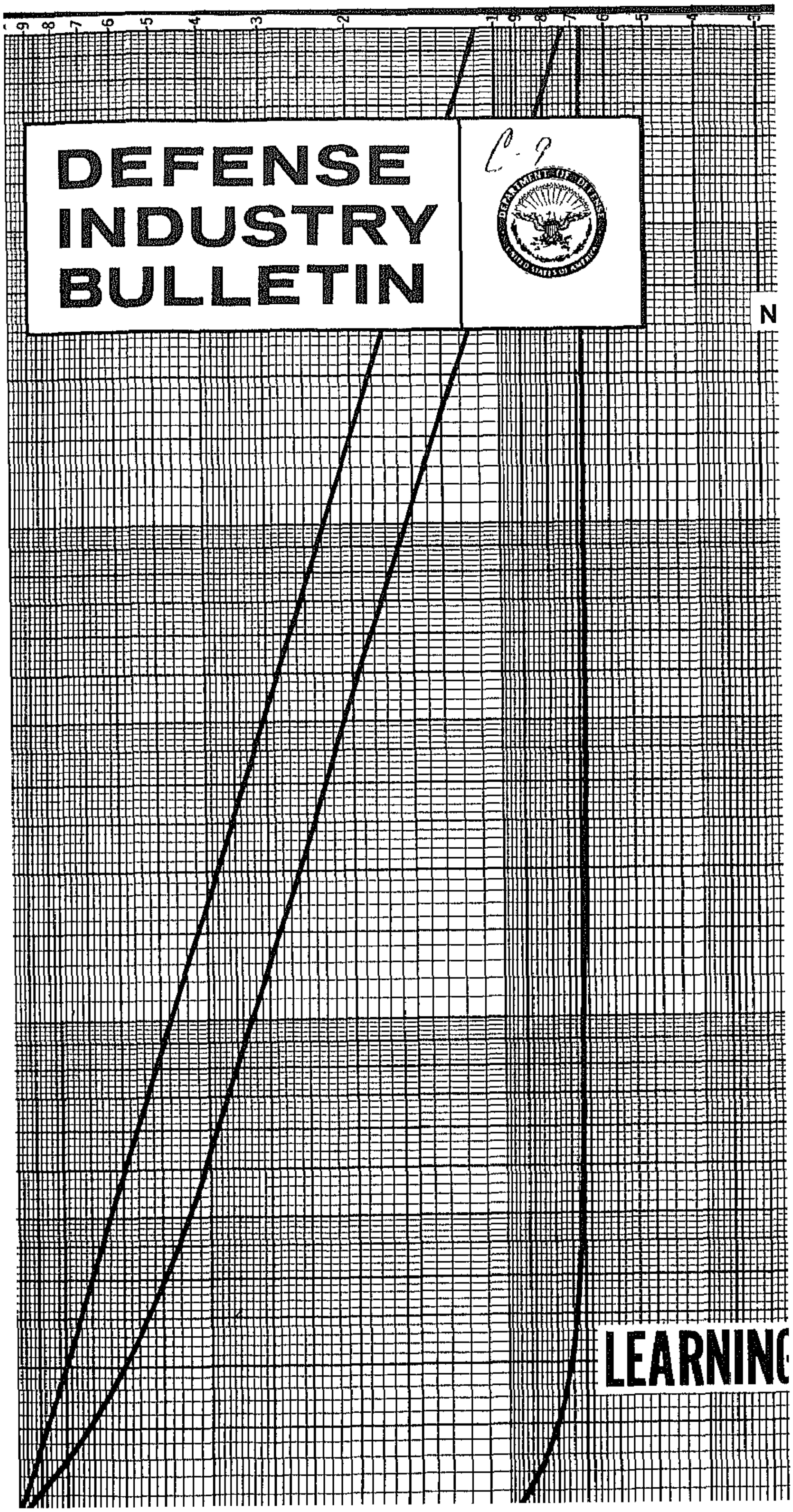

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LEARNING

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The *Defense Industry Bulletin* is published monthly by the Defense Supply Agency for the Department of Defense. Use of funds is approved by the Director, Bureau of the Budget.

The *Bulletin* serves as a means of communication between the Department of Defense, its authorized agencies, defense contractors and other business interests. It provides guidance to industry concerning official DOD policies, programs and projects and seeks to stimulate thought on the part of the Defense-Industry team in solving problems allied to the defense effort.

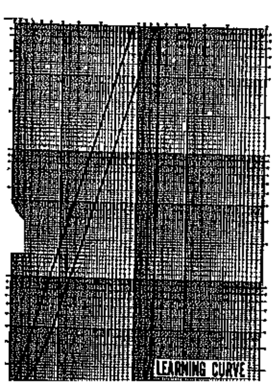
Suggestions from industry representatives concerning possible topics for future issues are welcome and should be forwarded to the Editor at the address

...tion, Hq., Defense Supply Agency (DSAH-B), Alexandria, Va. 22314.

IN THIS ISSUE

FEATURES

DEPARTMENTS



The application of "learning curves," as depicted on this month's cover, provides a manufacturer with a valuable tool in the development of cost factors associated with the production of today's complex defense hardware. A discussion of the subject appears in this issue.

Defense Department Announces Relocation of Defense Industry Bulletin

Responsibility for publishing the *Defense Industry Bulletin* has been transferred from the Office of the Assistant Secretary of Defense (Public Affairs) to the Director, Defense Supply Agency. The editorial office of the *Bulletin* is now located in Building 4, Room 4A 508, Cameron Station, Alexandria, Va.

Requests for new subscriptions, changes of address, and any other correspondence concerning the *Bulletin* should be addressed to: Editor, Defense Industry Bulletin, Defense Supply Agency (DSAH-B), Cameron Station, Alexandria, Va. 22314. Telephone number is (202) 974-7558/7559.

THE DEPUTY SECRETARY OF DEFENSE
WASHINGTON, D. C. 20301

As in the past, the Defense Department requires the continued support of American industry and labor to meet the requirements of national security. In 1965, the *Defense Industry Bulletin* was established to achieve increased public understanding of DOD policies, programs, procedures and technical developments. The need for a flow of this information is particularly important as we implement significant changes to improve our procedures over the full spectrum of military procurement.

In transferring responsibility for the *Bulletin* to the Defense Supply Agency, its mission will not change. I am confident that the *Bulletin* will continue to communicate pertinent information from all components of the Defense Department through timely news reports and authoritative articles.

David Packard

Weapons for Tomorrow, If...

Hugh E. Saunders

One "inventor" has an idea for an electric gun. Another sends in description of an invisible airplane. Yet a third suggests a means of powering a rifle with bottled gas.

Far out?

Possibly such proposals would be considered so in some circles, but not in the Future Weapons Systems Division of the U.S. Army Weapons Command (WECOM), located at Rock Island, Ill. Far from considering these ideas and suggestions as "nutty," the members of WECOM's Future Weapons Systems Division give serious consideration to each suggestion received. Although this is not their primary task, the members of the division, an element of the WECOM Reasearch and Engineering Directorate, continue to receive the "unsolicited proposals," as they dub them.

Not all of the ideas are too "far out" for serious consideration. Of the 67 unsolicited suggestions received during FY 1969, 2 are being pursued for further study under government contract.

The odds of getting an idea adopted as a formal project generally favor a industry- or university-based team of researchers rather than suggestions presented by an individual. This does not necessarily preclude acceptance of proposals from individuals; however, experience indicates that ideas which originate with a research team, will be better thought out, more comprehensive, and better aligned to the Army's requirements.

Unsolicited proposals are not limited to ideas for better rifles or invisible airplanes. During the past year, they have run the gamut from self-sharpening scissors to devices for employment in perimeter defense. They included such relatively complicated hardware proposals as air defense systems and defenses against mortars.

Nevertheless, unsolicited suggestions are an exception to the pattern which most industries follow. Most of them elect to participate in the U.S. Army Qualitative Requirements Information (QRI) Program. Under the provisions of Army Regulation 70-35, all Army agencies whose mission includes research, development, test and evaluation (RDT&E) are directed to participate in the QRI Program and designate a QRI Control Office and a QRI manager. Figure 1 lists the Army activities (one of which is the U.S. Army Weapons Command) which participate in QRI Program and includes the designation of control office and manager's name.

How Does a Company Participate in QRI?

Normally, industry participation in QRI is a four-step process. First, a company indicates an expression of interest. Most often, this is a letter simply stating the firm is interested in participating in QRI.

Second, the company executes a policy agreement for the release of QRI. This policy agreement establishes a legal basis for the release of Army QRI and the qualification of a company to participate in QRI.

Third, the firm must display that it has a research and engineering capability. Normally, this research and engineering capability is already in existence. However, when the organization's area of interest exceeds its present capability, the industry must furnish acceptable evidence of a solid and feasible intent to adequately expand the capability.

Last, the industrial organization must have a facility clearance and individual security clearances up to and including Secret. This is normally the least restrictive of the four requirements.

Once the industrial organization has met the four qualifications, the next step in the procedure is for the firm to receive a copy of the command's QRI Guide. The guide describes mission responsibilities, characteristics of some present and future weapons, and contains long-range research and engineering or development problems which require solutions.

Hugh E. Saunders serves in the Research and Engineering Directorate of the U.S. Army Weapons Command as coordinator of the Qualitative Requirements Information Program. In addition to his responsibilities regarding the QRI Program, he also handles unsolicited proposals and advanced planning briefings for industry. Mr. Saunders holds a B.S. degree in mechanical engineering from Iowa State University.

What Is QRI?

The definition of QRI is rather general. Basically, it is any information concerning current or future Army requirements for research and development.

More specifically, it may be one of two types of information. QRI may be information concerning current and future Army requirements for *applied research* to obtain knowledge, materials, techniques, or methods Alternatively, it may be information concerning current and future Army requirements for the *development* of new items, components, or materials.

The main purpose of QRI is to inform industrial organizations about Army requirement for new materiel, in order that they might most effectively conduct their voluntary developmental efforts. It has long been recognized in the Defense Department that many new ideas for weapons and other materiel are generated by industrial organizations on a voluntary basis.

Members of the Army Weapons Command welcome this interest and encourage the generation of new ideas from all sources. At the same time, they realize that there are frequent instances where costly and time-consuming voluntary efforts end in disappointment.

Disappointment can result from one of two causes. First, the originator of the idea is not aware of all aspects of the problem. Disappointment may also occur because the idea was not sufficiently compatible with all the factors which the Army Weapons Command must consider.

Review of the QRI Guide by the members of the industrial organization helps prevent this disappointment. Such a review provides the basis for developing proposals that respond to specific problems of the Army.

A proposal might be made for any one of a wide category of solutions. It might be for a lightweight low-cost propulsion system, for a lightweight artillery weapon, for the components of a hydrospring recoil mechanism, for a ballistic computer, for a silencer for a small caliber weapon system, or for a weapon system providing 10 to 1 superiority. It might be for a cupola with a complementary armament, for obturating seals for rapid fire artillery, for a device for the stabilization of vehicle-mounted weapons, for position and velocity indicators, or even for standard wire springs. It might be a solution for any one of a couple of dozen research or engineering problems.

Evaluation Process

Once a proposal is received in the headquarters of the Army Weapons Command, it is treated as a proprietary item. This treatment is in effect whether the response to the QRI is in the form of conversation, documentation, or models.

Proprietary treatment means that the material is *not* released outside the Army without prior permission of the organization submitting the material. Of course, it is conceivable that more than one industrial organization is interested in a given problem. Therefore, it follows that similar material can be received simultaneously from more than one source, or that material, similar to that which has just been submitted, is already available. This does not alter the protection that the members of WECOM will give to the material which has been submitted. It does mean that the receipt and evaluation of a proposal by WECOM does not imply a promise to pay, a recognition of novelty or originality, or any relationship which might otherwise require the Government to pay for the use of information to which it is otherwise lawfully entitled. However, the Army has no intention of using any proposal in which an individual or company has proprietary rights without proper compensation.

There is no prescribed format for the submission of proposals. However, the proposal should be made as comprehensive as possible. When a proposal that is specific to a QRI problem is submitted, a completed DD Form 1634, "Research and Development Planning Summary," should be enclosed as one page of the proposal.

When a proposal is received at WECOM headquarters, evaluation of the idea is initiated. The originator of the idea is informed of all decisions regarding possible acceptance, ideas concerning further development of the proposal, or rejection.

If the evaluation process indicates a promising solution, prompt action will be taken by WECOM to attempt to place the proposal in a funded program. Of course, the number of funded proposals is limited by the amount of funds available.

During the development of a proposal responding to an Army requirement, questions may arise about the proposal. These may be questions about technical requirements. In that case, a representative of WECOM is made available for consultation and guidance. Often during such conversations, the industry representative learns of other problems which, being relatively minor, have not yet been publicized. Then the logical thing for the industrial representative to do is to submit a proposal for the new problem which he had just discovered. This new suggestion is handled in the same way as unsolicited proposals from individuals.

Naturally, there are ways other than the QRI Program for industry to participate in WECOM's research or development programs. One of the methods is a presentation by industry before a technical audience composed of WECOM representatives. Another method is for the technical representative of an industrial firm to discuss his company's capabilities with members of WECOM. Like the unsolicited proposal, these methods involve greater risk of disappointment than formal participation by the company in the QRI Program.

Somewhat similar is the unfunded study program. The objective of this program is to assist qualified civilian organizations to conduct research and development studies which they initiate. Therefore, the civilian organization may find it advantageous to develop its study at its own expense. The Army provides a project coordinator and access, as required, to DOD data applicable to the study. In return, the results of the study are made available to the Army for future consideration. The unfunded study program requires the execution of an Unfunded Study Policy Agreement before progress can be made on each study.

Management of QRI in WECOM

WECOM has streamlined its QRI Program for the convenience of industry. Rather than have industry send proposals to each of the command's subordinates and other organizations with which it is closely allied, the QRI coordinator at WECOM acts as the single point of con-

Participating Agencies in U. S. Army Qualitative Requirements Information Program

Army Materiel Command Agencies

U.S. Army Tank-Automotive Command
Attn: AMSTA-H-L, Mr. Bird
Warren, Mich. 48090

U.S. Army Weapons Command
Attn: AMSWE-REF, Mr. Saunders
Rock Island, Ill. 61201

U.S. Army Munitions Command
Attn: AMSMU-RE-P, Mr. Watson
Dover, N.J. 07801

U.S. Army Mobility Equipment
Research & Development Center
Attn: SMEFB-CO, Mr. Rhodes
Fort Belvoir, Va. 22060

U.S. Army Electronics Command
Attn: AMSEL-PP-CI-APPI, Mr. Napier
Fort Monmouth, N J. 07703

U.S. Army Aviation Systems Command
Attn: AMSAV-R-R, Mr. Polotsky
P.O. Box 209, 12th & Spruce Sts.
St. Louis, Mo. 63166

U.S. Army Missile Command
Attn: AMSMI-RS-QRI, Mr. Hoft
Huntsville, Ala. 35809

Harry Diamond Laboratories
Attn: AMXDO-PP, Mr. Turner
Washington, D.C. 20138

Natick Laboratories
Attn: AMXRE-TP, Mr. Benedict
Natick, Mass. 01762

U.S. Army Test & Evaluation Command
Attn: AMSTE-PO-I, Mr. McGinnis
Aberdeen Proving Ground, Md. 21005

Aviation Materiel Laboratories
Attn: SAVFE-CP, Mr. Fenstermacher
Fort Eustis, Va. 23604

U.S. Army Aberdeen Research
& Development Laboratories
Attn. AMXRD-XTC, Mr. Zongker
Aberdeen Proving Ground, Md. 21005

U.S. Army Edgewood Arsenal
Attn: SMUEA-POPL-L, Mr. Hait
Edgewood, Md. 21010

Fort Detrick
Attn: SMUFD-PR, Dr. Gilford
Frederick, Md. 21701

Frankford Arsenal
Attn: SMUFA-A2100-11-2, Mr Peltee
Philadelphia, Pa. 19137

U.S. Army Materials &
Mechanics Center
Attn: AMXMR Mr. Darcy
Watertown, Mass. 02172

Picatinny Arsenal
Attn: SMUPA-VCI-I, Mr. Tyler
Dover, N.J. 07801

Nuclear Defense Laboratory
Attn. AMXND-NA-N, Mr Samos
Edgewood, Md. 21010

Watervliet Arsenal
Attn: SWEWV-RDP, Mr Roeck
Watervliet, N.Y. 12189

U.S. Army Small Arms
Systems Agency
Attn: AXXAA-XD, Maj. Medaris
Aberdeen Proving Ground, Md. 21005

U.S. Army Terrestial Sciences Center
Attn: AMXCR-TL, Mr. Floyd
Hanover, N.H. 03755

Other Army Agencies

U.S. Army Medical Research
& Development Command
Attn: MEDDH-M, Mr. Beall
Washington, D.C. 20315

Office of Chief of Engineers
Chief Scientific Advisor
Attn: ENGSA, Dr. Quarles
Washington, D.C. 20315

U.S. Army Engineer Waterways
Experiment Station
Office of Technical Programs
and Plans, Attn: Mr. Martin
Vicksburg, Miss. 39180

Engineer Topographic Laboratories
Attn: ETL-POC, Mr. Cook
Fort Belvoir, Va. 22060

U.S. Army Security Agency
Attn: IARD-T, Mr. Sluke
Arlington Hall Station
Arlington, Va. 22212

U.S. Army Research Office
Attn: CRDARO, Mr. Davidson
Washington, D.C. 20310

Figure 1.

tact for the headquarters and WECOM subordinate mission elements.

The subordinate organizations include the Rock Island (Ill.) Arsenal and Watervliet (N.Y.) Arsenal. Rock Island Arsenal is responsible for gun mounts for artillery, tanks, and other combat vehicles, as well as small arms and aircraft weaponization. Watervliet handles all types of artillery other than mounts. Two other organizations are closely allied with WECOM: Frankford Arsenal, Pa., and the Army Tank-Automotive Command, Warren, Mich. Frankford handles fire control (aiming) devices, while the Tank-Automotive Command handles the combat vehicle portion of the WECOM mission. Each subordinate mission element submits its problems to WECOM headquarters where they are consolidated into one QRI document.

In summary, any industry, with a capability and an interest in participating in the research or the engineering programs of WECOM, should explore the avenue of approach opened up by the QRI Program. Approximately 450 firms have already done so. The first step in joining the companies already participating is relatively simple. Just address a letter, expressing an interest in the QRI Program, to the Commanding General, U.S. Army Weapons Command, Attn: AMSWE-REF, Rock Island, Ill. 61201.

New Army Computer Unit Set Up in Hawaii

The Army Computer Systems Command (USACSC), Fort Belvoir, Va., has announced the activation of the USACSC Support Group (Pacific), Fort Shafter, Hawaii, as the command's newest field organization.

Initially, the group will be responsible for the continued development and maintenance of the Standard Supply System (3S) of the U.S. Army, Pacific. The 3S is a theater depot/inventory control center supply and stock fund data processing system for supply and related financial transactions of subordinate commands, located in Hawaii, Japan, Okinawa, Vietnam and Thailand.

Commanding the new unit is Colonel Robert G. Hillman.

Predicting Production Costs with Learning Curves

Wiley F. Patton

"Once you have the first satisfactory aircraft, how good are your cost estimates?"

"Plus or minus 3 percent."

This answer, by a representative of a giant aerospace company, may surprise anyone who is unfamiliar with industrial processes. Others will recognize immediately that the question is loaded.

The key qualification is that the first satisfactory aircraft has been produced. At this point, the manufacturer should know his costs, except for rework, in intimate detail. All blueprints should be on hand, all problems with respect to networks, activities, interfaces, time and other constraints, tradeoffs, engineering, tooling, subcontracting, specifications, materials, processes, and tolerances should have been faced up to and many solved satisfactorily. In addition, the thousands of people who have been involved have experience and records which will enable them to repeat their work and incorporate improvements on existing production equipment.

Before the manufacturer has produced his first satisfactory model, he does not know production costs with the same precision as he does after experiencing the costs of a completely finished product.What is contained in this article is applicable to recurring production costs *after* the first satisfactory model has been produced. The discussion here does not, it must be made plain, apply to costs of research, development, test and evalation, or the non-recurring costs of producing the first model.

This article is about the predictability of production costs after the first satisfactory model is built. It is about learning theory and learning curve models applied to industrial learning.

After the first production model is finished, the manufacturer is in a position to know his costs of the first of all components. In the parlance of the learning curve buff, he knows his "a" values for dozens of recurring costs elements at, perhaps, dozens of work stations. Starting with his costs of producing the first model as a known point and projecting a slope computed from learning curves experienced on roughly analogous aircraft produced previously, the manufacturer can project his estimates of later recurring costs. The representative of the aerospace company says his projections are within plus or minus 3 percent accuracy.

After the first aircraft is produced, the manufacturer, almost automatically, becomes "sole source" for all aircraft of the series. Any other manufacturer would have to go through at least the initial steps of the learning process: tooling, employing and training labor, and building his first production model.

After a few score aircraft have been produced, it is common for negotiators for the Service and for the "sole source" contractor to agree, within very narrow limits, on the estimated cost of future aircraft in subsequent production runs.

On one Air Force contract, negotiators were within 1 percent or less in agreeing on the estimated costs of future aircraft long before the first production run had been completed. In the example used in this article the negotiators' agreed upon estimates were within 1 percent of the actual costs of production.

This article illustrates how a few major summaries of costs can be made to reveal considerable information by applying the family of mathematical models known as learning curves. Examination of the mathematical models and some real life data, described herein, reveals dozens of facets not adequately covered in existing literature on learning curves. Four facets are most interesting:

- The Nth unit learning curve is convex, which we will demonstrate mathematically. The demonstration will emphasize the experts' advice, "don't project learning curves too far," at least not as a single straight line. This demonstration leads logically to the suggestion that, for improved curve fitting, a series of straight lines is a useful technique.
- Precision can be added to an old tool by substituting mathematical

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values of cumulative average costs and the Nth unit costs for visual reading of the values from log-log charts.

• How to use mathematical tables to move from cumulative average values to Nth unit values is demonstrated, using real-world data.

• Projection of functional dollar costs separately is proposed. (Actual historical dollar costs are already influenced by inflation; thus, the projection can be made with probable accuracy unless the *rate* of inflation changes.)

The following discussion of these applications of learning curves is admittedly incomplete. Indeed, a variety of issues are raised by learning theory, but only the most interesting can find space to be mentioned here.

The words "learning curve" are widely used, have a variety of meanings, and are frequently used more or less interchangeably with "progress curve" and "experience curve."

"Learning curve" is defined here as a line on a graph (logarithmic or arithmetic). When defined in this way, it expresses the idea that the time to do the job will decrease, hopefully, each time the job is repeated. The amount of decrease will be less with each successive unit. By extension, the name "learning curve" is also applied to the data on which the line is based.

The psychologist, in his own field, uses the term "learning curve" to describe a basic human characteristic. In doing a job, an individual reaches successive "plateaus" of learning where no improvement in his skill can be detected for a time. There is no advance warning when the individual is able to move to the next higher plateau in his skill. No mathematical models show what to expect from an individual. One never knows when the highest plateau has been reached. Consider the blind poet Milton; the deaf musician Beethoven; the once tongue-tied orator Demosthenes; the once crippled boy, later holder of the world record for the mile run, Glenn Cunningham.

In the industrial field, however, where hundreds or thousands of individuals are involved in the learning process together, the law of large numbers applies. Statisticians can develop mathematical models to describe the learning process of a large number of workers, or of the enterprise.

T. P. Wright in "Factors Affecting the Costs of Airplanes," *Journal of Aeronautical Sciences*, February 1936, published the first authoritative paper on the subject. He pointed out that the "cumulative average cost" of direct manufacturing man hours in producing airframes tended to be a straight line when plotted on log-log paper and to have a slope which tended to be 80 percent. His mathematical formula or model $y = aX^b$ (where X is the cumulative average cost) also defines the fixed convexity of the Nth unit curve.

J.R. Crawford, in "Asymptotic Progress Curve Tables," published by the Lockheed Aircraft Corp. in 1945, first produced "progress curve" data based on the idea that the Nth unit cost of airframes was a straight line on log-log paper. The change in the underlying mathematical model was made to get away from the "bundlesome" exponential formulas needed to project costs of future units under the Wright formula. His formula is $y = ax^b$ (where x is the Nth unit cost).

To the lasting confusion of all, both definitions are accepted as proper without even referring to the Crawford formula as the "modified" definition. Figure 1 shows graphically the difference between the two 80-percent learning curves and a test for *parallelism*. (The Crawford cumulative average curve which arches from the starting point above the straight line is omitted.)

Harold Asher in "Cost Quantity Relationships in the Air Frame Industry," Rand Corp. R-291, July 1, 1956, published an exhaustive review of the literature extant on the subject through 1955. He pointed out that the higher the starting point on the progress curve for an airframe, the steeper the slope tends to be. He elaborated on the implications of the difference in progress curve slopes between various production jobs. He was well aware that there are differences in progress curve slopes of direct manufacturing man hours among various production jobs incorporated in one figure, and that the Nth unit curve for labor was convex.

Note that the subject had grown even more complex. In addition to the problem of "convexity," it had been found that, in general, the higher the starting point of the curve, the steeper the slope tended to be.

Other, lesser known studies attempted to establish formulas for learning curves involving variations from a straight line on log-log paper.

It is worth digressing a moment to note that log-log paper is widely used for learning curve presentation and is unquestionably a useful tool. On the

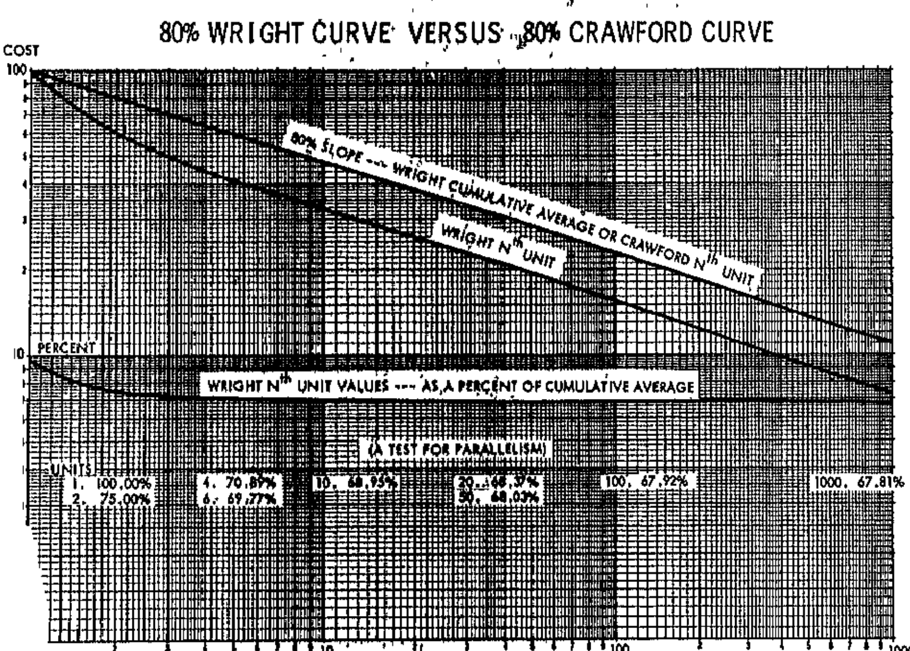

Figure 1.

Progress Curves

N	76.0 CUM TOTAL	76.0 C.A.	76.0 UNIT	77.0 CUM TOTAL	77.0 C.A.	77.0 UNIT	78.0 CUM TOTAL	78.0 C.A.	78.0 UNIT PAGE 241
1	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
2	1.75999999	0.88000000	0.76000000	1.77000000	0.88500000	0.77000000	1.77999999	0.88999999	0.77999999
3	2.40728271	0.80242757	0.64728272	2.43083349	0.81027783	0.66083351	2.45448762	0.81816254	0.67448763
4	2.98488271	0.74622068	0.57759999	3.02373350	0.75593337	0.59289999	3.06288761	0.76572190	0.60839999
5	3.51364166	0.70272833	0.52875894	3.56878760	0.71375752	0.54505412	3.62451908	0.72490381	0.56163146
6	4.00557649	0.66759609	0.49193487	4.07762939	0.67960490	0.50884180	4.15061945	0.69176991	0.52610035
7	4.46838516	0.63834073	0.46280863	4.55773765	0.65110538	0.48010825	4.64843816	0.66406260	0.49781875
8	4.90736115	0.61342014	0.43897600	5.01427066	0.62678383	0.45653300	5.12299019	0.64037377	0.47455200
9	5.32633609	0.59181511	0.41897491	5.45097160	0.60566351	0.43670092	5.57792372	0.61976930	0.45493356
10	5.72819287	0.57281929	0.40185679	5.87066323	0.58706632	0.41969167	6.01599628	0.60159963	0.43807253

Figure 2.

other hand, mathematical models are even more useful and can reinforce one's appreciation of both the utility and shortcomings of log-log paper.

Despite the confusion and complications already described, a young statistician, industrial engineer, or capable clerk can use an easily verified technique to find and interpret learning curves. The technique is not dependent on reading values from log-log graph paper. It uses ready-made progress curve tables based on mathematical models (see Figure 2.)[1]

[1] *For an example of tables of learning curves, see Fowlkes, Tommie F., "Aircraft Cost Curves, Derivation Analysis Projection," Ft. Worth: General Dynamics Corp., 1963.*

The following case study illustration uses actual figures for all functional costs, which have been "adjusted" by a common factor. The original proportional relationships are undisturbed (see Figure 3). The clerical analysis recommended herein will produce a very respectable amount of useful information. The progress curve tables used in this illustration are based on the concept that the Nth unit values forms a straight line (see Figure 1).

Using the Learning Curve Tables

In predicting costs or in negotiating a price for a follow-on contract, it is useful for negotiators to know the recurring costs of production, and progress slopes for the several functional factors of production, *e.g.*, engineering, tooling, manufacturing. In our example we have chosen to work with costs incurred after production of 6 units and 133 units. At the time of negotiation, it is also necessary to evaluate the need for additional "non-recurring costs."

By extracting information from the published tables and from known cost information, and by making simple calculations, the young statistician or analyst can construct two tables of learning experience for the negotiators. The first table relates cumulative *total* costs to appropriate learning curves, and is the basis for the second table. The sec-

Reported and Derived Cost Information

(Recurring Costs as Reported—Dollar Figures in Thousands)

	Cumulative Costs 6 Units	Cumulative Costs 133 Units	Cumulative Average Costs 6 Units	Cumulative Average Costs 133 Units	133rd Unit Cost (Derived)
Engineering	$ 3,851	$ 44,491	$ 641.8	$ 334.5	$ 257.6
Tooling	2,347	31,567	391.2	237.3	195.3
Quality Control	2,256	16,041	376.0	120.6	72.1
anufacturing	47,625	299,646	7,937.5	2,253.0	1,248.2
Material	9,161	112,028	1,526.8	842.3	666.8
r Direct Costs	5,764	20,575	960.7	154.7	65.0
quipment	3,342	72,144	557.0	542.4	589.7
ther	444	3,482	74.0	26.2	16.6
Sub total	$74,790	$599,969	$12,465.0	$4,511.0	$3,060.8*
Deferred	(3,434)	(3,434)	(572.3)	(25.8)	—
Total	$71,356	$596,535	$11,892.7	$4,485.2	$2,937.8

e cost of the 133rd unit ($3,060.8) based on the sum of the individual cost element projections is more reliable than the projection based on the combination of ments ($2,937.8).

Figure 3.

Learning Curve Data

Cumulative Total Costs

Col 1	Col 2	Col 3	Col 4 (2 ÷ 3)
Percent Slope or Cost Category	Cumulative Total Costs Table Values or $ Values 6 Units	133 Units	Ratio 6 Units to 133 Units
Other Direct Cost	$ 5,764,000	$ 20,575,000	28.01*
67	3.39872169	16.87963462	20.30
68	3.46249077	18.05397177	19.20
69	3.52716672	19.30737424	18.28
70	3.59275299	20.64442110	17.40
71	3.65925294	22.06990361	16.60
Mfg. Labor	$47,625,000	$299,646,000	15.89*
72	3.72667000	23.58883405	15.83
73	3.79500756	25.20645213	15.05
74	3.86426890	26.92823339	14.35
Quality Control	$ 2,256,000	$ 16,041,000	14.06*
75	3.93445745	28.75989652	13.70
76	4.00557649	30.70741153	13.05
Other	$ 444,000	$ 3,482,000	12.75*
77	4.07762939	32.77700806	12.45
Total	$71,356,000	$596,535,000	11.96*
78	4.15061945	34.97518301	11.88
79	4.22454983	37.30871010	11.30
80	4.29942399	39.78464746	10.80
81	4.37524503	42.41034651	10.30
82	4.45201629	45.19346237	9.75
83	4.52974099	48.14196110	9.40
84	4.60842234	51.26413012	8.97
Engineering	$ 3,851,000	$ 44,491,000	8.66*
85	4.68806350	54.56858778	8.57
86	4.76866770	58.06429243	8.21
Raw Material	$ 9,161,000	$112,023,000	8.18*
87	4.85023808	61.76065241	7.86
88	4.93277782	65.66703701	7.50
Tooling	$ 2,847,000	$ 31,567,000	7.43*
89	5.01629013	69.79378605	7.20
90	5.10077804	74.15122032	6.88
91	5.18624479	78.75015163	6.60
92	5.27269340	83.60179520	6.30
93	5.36012703	88.71777725	6.05
94	5.44854873	94.11015224	5.78
95	5.53796154	99.79140854	5.54
96	5.62836862	105.77448177	5.32
97	5.71977299	112.07276821	5.12
98	5.81217760	118.70013332	4.91
99	5.90558565	125.67092896	4.80
Equipment	$ 3,342,000	$ 72,144,000	4.63*

*Calculated percentage, numerically ordered.

Figure 4.

ond table relates cumulative *average* recurring costs to the learning curve to find the cost of some subsequent unit, the 133rd unit in our example. Examples of the two tables are Figures 4 and 5, respectively.

The analyst must first post from the published learning curve tables the values for cumulative *total* costs for 6 units and 133 units. (This matches the structure for functional costs; the dollar figures are reported as cumulative total costs in Figure 3.) The analyst must calculate the ratio of the cumulative total cost of 6 units (column 2, Figure 4) to 133 units (column 3) for all table values and post these in column 4. He must also figure the same ratio for the functional cost summaries. Then he distributes the ratios for the functional cost data in numerical order, between the next highest and next lowest ratio of the table ratios he previously calculated. For example, manufacturing labor falls between the rows representing 71-percent slope and 72-percent slope, its position being determined by ratios in column 4. Quality control costs fit somewhere between the 74-percent and 75-percent slopes. By this simple process, the analyst has placed all functional costs on their approximate cumulative total learning curves.

Note that an error in posting a "table value" in the series would distort the expected ratio and could be spotted immediately by the professional supervisor.

Unit Cost Table

The next step is to calculate the cost of the 133rd unit, based on information available and developed previously. This step will produce the table in Figure 5.

From the progress curve tables the analyst posts the cumulative *average* cost of 133 units and the *unit cost* of the 133rd unit for each experience curve. He then calculates the ratio of the unit cost to the cumulative average cost to produce column 8, Figure 5. (Calculations of the ratios may be reversed, provided the functional cost data is treated the same way as the table values.)

The *cumulative* dollar cost of the 133 units must be divided by 133 to obtain the cumulative *average* cost from the data furnished in Figure 3. These cumulative average costs for each functional category must be interspersed at exactly the same points as determined earlier for cumulative total costs, Figure 4. Based on interpolation from column 4 of the cumulative total costs table, the Nth unit cost ratio may be determined for posting in column 8 of the cumulative average costs table, Figure 5.

Next, the ratio for each functional cost is multiplied by its cumulative average cost to find the cost of the 133rd unit, the Nth unit, for posting in column 7, Figure 5.

Note on Figure 5 that manufacturing labor costs for the 133rd unit are 55.4 percent of the cumulative average cost; quality control costs for the 133rd unit are 59.75 percent of the cumulative average cost.

Professional Interpretation Required

Note that the sum of the functional cost, all assumed to be straight lines on log-log paper, is greater for the 133rd unit than the projection of the total cost, calculated in the same manner; $3,060.8 thousand versus $2,937.8 thousand. Thus, the nonlinearity of a summary cost curve made up of curves of different slopes is apparent. This demonstrates why one does not project a learning curve too far.

Even the sum of the functional costs ($3,060.8 thousand) will be lower than the actual cost of the 133rd unit, because some of the functional cost curves are also not linear, a factor not considered here. For example, with respect to direct manufacturing labor costs for the aircraft selected as the example, a straight line, as calculated, overstates the cost of items 2 through at least the 50th unit. A straight line understates the cost of item 1 and beyond about item 70 to the end of the series. Considerably less is known about the shape of the other functional cost curves.

With periodic summaries of cumulative costs for 1 unit, 6 units, 25 units, 133 units, etc., it would be possible to calculate a series of slopes between these points to approximate

Learning Curve Data

Cumulative Average Cost & Nth Unit Cost

Col 5 Percent Slope or Cost Category	Col 6 Cumulative Average Recurring Cost 133 Units	Col 7 133rd Unit Recurring Cost	Col 8 Percent 133 Unit Cost of Cumulative Average Cost
Other Direct Costs	$ 154,000 [a]	$ 65,000 [c]	42% [i]
67	.12691455	.05928005	46.709
68	.13574415	.06581169	48.482
69	.14516822	.07295159	50.253
70	.15522121	.08074685	52.020
71	.16593912	.08924536	53.781
Mfg. Labor	$2,253,000 [a]	$1,248,200 [c]	55.4% [i]
72	.17735965	.09850096	55.537
73	.18952219	.10856858	57.285
74	.20246792	.11950686	59.025
Quality Control	$ 120,600 [a]	$ 72,100 [c]	59.75% [i]
75	.21623982	.13137778	60.75
76	.23088279	.14424681	62.476
Other	$ 26,200 [a]	$ 16,600 [c]	63.3% [i]
77	.24644367	.15818307	64.187
Total Costs*	$4,485,200 [a]	$2,937,800 [c]	65.5% [i]
78	.26297130	.17325945	65.885
79	.28051662	.18955280	67.573
80	.29913268	.20714406	69.248
81	.31887478	.22611842	70.911
82	.33980047	.24656554	72.562
83	.36196963	.26857963	74.199
84	.38544459	.29225972	75.824
Engineering	$ 334,500 [a]	$ 257,600 [c]	77.0% [i]
85	.41029013	.31770978	77.435
86	.43657362	.34503891	79.033
Raw Material	$ 842,300 [a]	$ 666,000 [c]	79.1% [i]
87	.46436506	.37436156	80.168
88	.49373712	.40579769	82.189
Tooling	$ 237,300 [a]	$ 195,300 [c]	82.3% [i]
89	.53476531	.43947300	83.741
90	.55752797	.47551911	85.291
91	.59210640	.51407377	86.821
92	.62858492	.55528110	88.338
93	.66705096	.59929175	89.842
94	.70759513	.64626318	91.332
95	.75031134	.69635988	92.809
96	.79529686	.74975356	94.273
97	.84265239	.80662346	95.724
98	.89248221	.86715650	97.162
99	.94489420	.93154763	98.588
Equipment	$ 542,400 [a]	$ 539,700 [c]	99.5% [i]

*The sum of the elements is $3,060,800 and is more accurate than the $2,937,800 shown.
[a] Average cost.
[c] Calculated value.
[i] Interpolated value.

Figure 5.

the true shapes of the Nth unit cost curves. In this way, if one knows the starting point and additional points on either the cumulative average or Nth unit curves, human endeavor can be compared with existing mathematical models with closer fit of the data.

Note that the computations of the recurring cost elements of the 133rd unit are based essentially on interpolations within the published logarithmic tables. Note also that the range of values between interpolation points are small, except at the extremes of the published tables; at slopes greater than 67 percent, where "other direct costs" occur; and at slopes smaller than 99 percent, where "equipment" costs occur. Errors in interpolation cannot exceed a fraction of 1 percent of the total cost.

One peculiar feature of the technique might be overlooked. Historical dollar figures are shown and they already contain an inflationary factor. (The generally accepted rate is 3 percent a year.) Further inflation will not affect the projection of functional cost data, unless the *rate* of inflation changes.

The demonstrated non-linearity of the "total costs" learning curve warns against projecting even the functional costs curves too far into the future, because they also are almost certainly not linear. A series of straight lines to approximate actual experience would make the existing mathematical models far more useful in projecting later costs.

Learning Curve on Log-Log Paper

The data calculated for direct manufacturing labor costs are shown graphically on log-log paper (Figure 6).

It is not necessary to read values from the chart. All needed values have been calculated by using published experience curve tables and raw data. Note that the dollar values used as input could relate to any item of hardware without affecting the methodology.

The computations illustrated in this article can be made without a thorough understanding of statistical, psychological, mathematical, or economic theory, or industrial engineering. The methodology has been shown in considerable detail so that the steps may be easily duplicated for various quantities to fit the raw data available. The method is not limited to any industry or any particular group of costs.

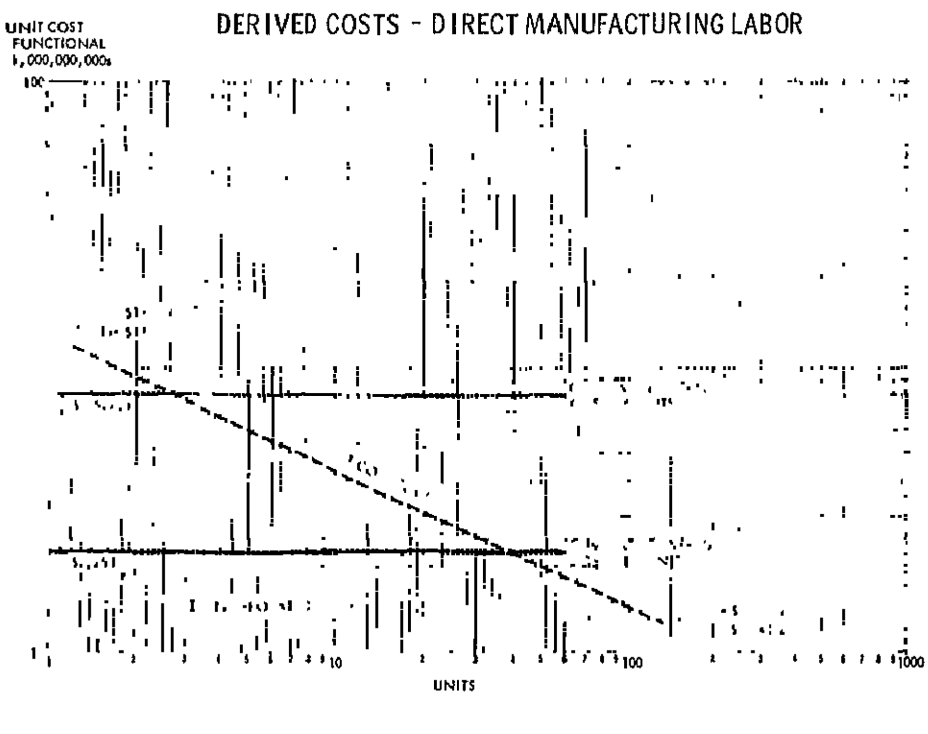

Figure 6.

DOD Expands Voice, Data Communications Systems

Three automatic communication systems serving the Defense Department and the Military Services are being expanded to meet increasing needs.

The first, the Automatic Voice Network (AUTOVON), has activated four new switching centers in Europe, and one in the Panama Canal Zone, to include these areas in DOD's worldwide AUTOVON system. The new centers, at Hillingdon, England; Langerkopf and Feldberg, Germany; Naples, Italy; and Corozal, Canal Zone, are part of an AUTOVON network that will eventually link more than one million telephones, teletypewriters and high-speed data sets at 2,000 military bases. The system is expected to be fully operational in 1971.

The second expansion is of the DOD's Automatic Digital Network (AUTODIN), which is receiving 17 overseas installations of the Digital Subscriber Terminal Equipment (DSTE). The terminals, customized to meet the needs of the individual units, will eventually eliminate the present system of separate teletype and data card terminal equipment. Present industrial contracts for this equipment will be terminated as the DSTE installations are completed, totalling 1,046 processing terminals around the world.

The third system is the Air Force Automatic Digital Weather Switch (AWDS) installation at Carswell AFB, Tex., part of the Automatic Weather Network (AWN). With activation at the end of the year, the new AWDS will join switches in Japan and England to provide Air Force bases around the world with access to the services of AWN. AWN is a computer system for collecting, editing and delivering weather data. Global weather conditions are relayed via AWN to the Air Force Global Weather Central, Offut AFB, Neb., where they are refined into atmospheric analyses and forecasts to be distributed back through AWN to worldwide users.

FROM THE SPEAKERS ROSTRUM

Transportation: Consider the Total Cost Equation

General F. J. Chesarek, USA

Address by General F. J. Chesarek, USA, Commanding General, Army Materiel Command to the 24th Annual Transportation and Logistics Forum, National Defense Transportation Association, Atlanta, Ga., Sept. 23, 1969.

In July, when Neil Armstrong and Buzz Aldrin were speeding back to Earth at several thousand miles an hour from their historic walk on the moon, the United Press International reported on a 72–year old man who was making his third cross-country trip in a red wagon pulled by a 14-year old mule. Taking 10 months to make the journey across the United States—from Iron City, down here in southwestern Georgia, to Garden Grove, Calif.—and needing 22 pairs of mule shoes for the journey, this earth traveler named Moe Mobley said; "I'm in no hurry to get nowheres. I'll get there when I do." He also commented that "folks who travel on them highways is in a big hurry to get somewhere and they ain't nowhere when they get there."

Unfortunately, the Army is usually in a big hurry to get somewhere; and when we get there, we are definitely someplace, even though we may not be particularly thrilled at the environment in which we find ourselves.

I remind you of the mule story, not because the mule is the Army's mascot and old friend of a bygone era, but to return you to a more earthy mental posture after National Aeronautic and Space Administration's brilliant moon adventure.

A further spur to our imaginations along the theme of this year's forum, "Transportation—New Horizons", was contained in a lead article in the September issue of the *National Geographic* entitled "The Coming Revolution in Transportation", which I'm sure you have all read with proud and anticipatory approval. It speaks of hovercraft, automated electric automobiles, the civilian version of the C–5A aircraft, automated airports of tomorrow, high speed trains, robotized shuttles, tube trains suspended and propelled by compressed air, and busses and houses that fly, among other marvels of human imagination.

One major ingredient was missing in the article—the mundane issue that caused Moe Mobley to use a mule on his trip west—and that is cost. This is the theme on which I will concentrate, because cost has become the dominant consideration in defense management.

Today we are facing a national crisis. This one is different in that the attack is internal, with the credibility and capability of Defense Department officials at all levels to manage their affairs being challenged on all fronts.

The challengers have a wide array of purpose. There are those who are seeking to change our foreign policy and international commitments by attacking the defense apparatus which supports existing foreign policy. Another group seeks to change our national priorities by reducing the resources allotted for defense and applying these resources to a wide assortment of domestic needs.

These first two groups apply what might be described as the Rubber Russian concept in support of their positions. In applying this concept, one stretches or compresses the threat analysis, usually by focusing on enemy intentions rather than on enemy capabilities. In this instance, the dangers posed by world instability are played down, indicating that the continuation of a strong defense force is unnecessary. At the same time, these groups say that we in the defense establishment apply the concept in reverse where, by appropriate stretching, we indicate that our current capability is insufficient to meet the threat posed.

There is a third group of critics—those who are seriously concerned over our managerial procedures and the need to eliminate waste in the defense appropriation of over $75 billion.

This third group can be further broken down into two subgroups: First, those who apply the principle of well-balanced inadequacy. This is best described by the old maxim: "A chain is only as strong as its weakest link." Any analyst well tuned to the principle of well balanced inadequacy would recognize that the solution is to weaken all other links, thereby bringing all parts of the chain into inadequate balance. The other part of this third group of critics are those who are knowledgeable of the profession of management and who have been seeking out legitimate soft spots.

As the Army Materiel Command spent about $14 billion of the defense budget last year, needless to say we take very seriously the views of our informed critics.

Let me start with the flat statement that we can do a better job in managing the resources entrusted to us. I know of no industry, governing body, or any other institution that has reached an unchallenged summit of managerial excellence.

Part of the Army's current requirements is for the transport of people and things. In FY 1969, the Army spent about $2 billion for this purpose and estimates that it will spend approximately the same amount in the current fiscal year.

This, however, is just the pure transportation cost and, therefore, is an inaccurate measure of what the movement of people and things really costs, because closely associated are the costs of packaging, preservation, in-transit losses, loading and unloading, and other associated elements. All these things should be grouped under the heading "cost of transportation."

Your industry has not been totally blind to these associated costs. The containerization program is a noteworthy advance, and the degree to which containerization has thus far been applied is only step one in its evolution. But I believe that if true progress within rational financial constraints is to be made, the transportation industry should take the lead in breaking out all aspects of the cost of transportation and directing funds and talent to devise ways and means to drive down this total cost.

Containerization

Let's look first at containerization, which does address several elements of this total cost equation. In order to do so, I should mention briefly the present process of supporting our forces in Vietnam. Most materiel is packaged and shipped from depots in the United States to a port. At the port, packages are segregated by destination and decisions made as to what goes by containers or in bulkshipments. Containers are then stuffed and loaded aboard ship. At the far end of the pipeline, the materiel is unloaded from the container and binned or stored in a depot in Vietnam from whence it is issued as required.

In the early stages of the war, we had no offshore depots, so the ports became clogged, material was stacked up wherever there was room, and the weather played havoc, as did pilferage and just plain loss.

How much better it would have been had we designed containers as segments of a depot—all binning, marking, and documentation at the depot in the United States where time and talent were available. Then, we could have moved the containers by rail piggyback or on wheels to the port and, thence, to Vietnam where they would be moved unopened to a depot site. Fifty, one hundred, or any required number could be arrayed in an appropriate geometric pattern. The supply people would operate out of the containers—no loss, no missing documentation, no weather problems, no multiple handling. Then, as onshore construction proceeded, the contents of the containers could be moved by their built-in sections into the fixed depots. By that time, sufficient retrograde cargo would have been developed to fill the containers and send them home loaded. While we cannot prove it yet, I am certain that the costs of immobilizing several hundred or even thousands of containers for up to six months, or even longer, would be a mere fraction of the cost of doing it the hard way.

We are making a detailed cost analysis of this approach and will call on this Association for assistance as required.

While on the subject of containerization, we have really not scratched the surface of innovative uses for these interesting boxes—for prepackaged fire control centers, command posts, mobile shops, and communications centers. Our heavy-lift helicopters should be designed to carry them from shipboard to actual points of use. We are also looking at a concept of thru-put supply—from our depots or factories direct to the field units.

Packaging, Marking, Documentation

Now let me turn to another costly aspect of the total transportation bill —packaging, marking, and documentation. Here again, while advances have been made, I think we are still operating a feudal system, because there is no integrative mechanism which tells us what is best for the transporters, receivers and shippers.

The Defense Supply Agency is experimenting with new techniques using the Fairbanks Morse Corp. in-motion weighing and cubing machine, called the Caprocon. The depot at Ogden, Utah, has had the Caprocon complex in operation for two years now. Besides automatically giving the weight, cube and piece data, it assists in the preparation of gummed labels which are used in the preparation of bills of lading.

More importantly, the future plans call for the mechanization of their freight terminal. This will give them a highly automated/mechanized packing, containerizing and handling facility for both freight and parcel post. Caprocon assisted in the operational concepts and preliminary design of that facility.

Also, plans are being developed for a system to provide computer-prepared continuation sheets for government bills of lading. The system would use the address file and freight data file now in the computer memory along with specific weight, cube and piece data, provided by the Caprocon, for each shipment unit. In addition to the preparation of the government bills of lading, the computer will be used to route, locate and manage material in process in the mechanized freight terminal. Also planned is the production of shipping address labels or stencils for automatic application on containers as they pass through the Caprocon.

In packaging, we need much new thought and imagination. I have not seen much which minimizes cost while providing the requisite protection. It is becoming a self-contained industry whose motives, I'm sure, are good but which does not, in my opinion, give appropriate consideration to cost.

Materials Handling Equipment

Next, a comment on materials handling equipment, or lack thereof. We should be devising or selecting handling systems that are best suited to our military environment—a system specifically designed to complement the site, climate, labor, connecting transportation systems, and other critical features of an area of operations. What this means is that what works in Europe may not in Vietnam, and what is good for peacetime purposes may be quite unsuited for military contingencies.

In advanced countries, distribution of goods is the third largest cost of doing business, topped only by the costs of labor and materials. It offers the greatest opportunity for using new efficiencies to reduce cost. One might say that the first great revolution in American transportation took place years ago when the rails of the Union Pacific and the Central Pacific met and welded a nation together. The second revolution was the development of truck transport; the third, movement of cargo by air.

Today we have the capability of initiating a fourth revolution based on managerial potential: the welding together of the capabilities of our rail-

ways, highways, airways, waterways, and the associated elements which go to make up the total cost of transportation into a great, unified, cost-effective transportation system capable of meeting the staggering demands of the future. We commonly refer to this as intermodal transportation—an area fertile with opportunities for savings for customers as well as suppliers from through rates and single carrier responsibility. If we had a good, dependable transportation service, we could reduce inventories and move into the big tent in cost reduction.

Paradoxically, transportation, as viewed by a major customer, is in many respects an industry divided against itself. It consists of many separate interest groups—shippers, carriers, suppliers, investors—which form interacting alliances against each other to resolve specific issues that affect the industry as a whole. As I mentioned previously, the situation is further compounded when we look at the accessory industries of packaging, materials handling, etc. I do not know whether this great Association has attempted to broaden its spectrum by joining with the associations supporting these other industries. I hope you do so, and quickly. There is a lot of gold to be mined in developing strong integrative links of all industries which contribute to the total cost of transportation.

All of this is a far cry from the exciting future held out for space exploration and the visionary adventures which such exploration conjures in our minds. What I have been talking about is what we live with day to day and, as the Army is obviously a good customer of your industry, it is our duty to challenge you to provide us a better service at less cost, just as we are doing with industries associated with research, development, and production.

The Army is pressing for economies in every aspect of logistic endeavor. Because your share of this pie is so substantial, we must look to you for help. The Army would be very pleased to establish a joint panel with this Association to explore further the potentials I have touched upon and any others you may have in mind.

Does the Air Force Really Want Value Engineering?

Address by Lt. Gen. H. E. Goldsworthy, USAF, Dep. Chief of Staff (Systems and Logistics), Hq., U.S. Air Force, at the Air Force Systems Command/Industry Conference, Colorado Springs, Colo., Sept. 29, 1969.

I welcome the opportunity to participate at this Air Force Systems Command/Industry Value Engineering Conference. The theme, "Value Engineering: Responsibility of Management," is, I believe, particularly timely. Defense Department managers at all levels, and their industry counterparts, are under considerable pressure to find more effective and less costly ways to adequately provide for this country's defense. It is quite clear that the challenges to management, both in Government and industry, will be ever greater in the foreseeable future.

Even the most ardent supporter would not suggest that value engineering holds the solution to all of our complex management problems. It is a discipline, however, designed to promote the achievement of essential functions at the lowest prudent cost. Value engineering, therefore, deserves our careful attention to determine whether or not it is being exploited to the fullest. A conference of this type provides all of us with the opportunity to explore the application of value engineering to a cross-section of industrial and defense operations. In the process, we gain an appreciation of the successes and problems of one another.

For the purposes of this conference, I consider it appropriate to address the contractor value engineering programs and, more specifically, that part of the program directly related to contractual requirements as specified by the value engineering clauses in defense contracts. It is in this area that I believe we here have our greatest mutual interest.

I have been asked to address the rhetorical question: "Does the Air Force really want value engineering?" The answer is obviously a resounding and unqualified "yes." Otherwise, I am sure we would not be here.

Why do we bother, then, to ask the question? Since its inception, the value engineering program has been beset with misunderstanding and inhibiting inuendo. It has been necessary for us to constantly reassure our contractors of our sincere intentions. This conference is only one of many such efforts. Though we believe much progress has been made in gaining better understanding, much remains to be done.

In 1967, the Defense Department directed the Logistics Management Institute (LMI) to undertake a study to determine whether significant opportunities exist for increasing defense industry participation and effectiveness in the DOD value engi-

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neering program. Also, the General Accounting Office (GAO) conducted a review of the Defense Department to determine how the value engineering progam was being managed.

The findings and conclusions of these two reviews are strikingly similar. While recognizing past accomplishments, both reviews indicated that much greater savings could result from an improved and intensified value engineering program. The summary of the LMI review stated that ". . . significant opportunities exist for increasing defense industry participation and effectiveness in the DOD value engineering program through stimulating a much greater exploitation of the 'savings sharing' potential of industry-initiated Value Engineering Change Proposals (VECPs)."

Both reviews were in substantial agreement as to the factors which were inhibiting value engineering and what was needed to effect improvements. I would like to identify and briefly discuss some of these with you. First, however, to put value engineering in perspective, let us look at the general environment in which we operate and where we are today.

Past Value Engineering Experience

In the past five years, Air Force saving realized from approved Value Engineering Change Proposals was $103.8 million. These "saved" dollars became available for other urgent requirements.

In the Air Force, we have experienced a generally upward trend in VECP submissions, approvals and dollars savings since we first started using value engineering clauses in ontracts. Frankly, while we derive me gratification from this record, ien we consider the increased dollar ue of contracts with value engiring provisions during these same 's and the resultant increased opmities for saving, we have to ide that the growth has been ian spectacular.

Air Force expects, starting in Y 1970, and every year therehile defense spending remains ially at the present level, to ich year the amount of dollar realized from VECPs. We inue with this objective until atisfied that the potential of ram has been realized.

If this seems ambitious, reflect for a moment on the experience of the Air Force Systems Command (AFSC), which is representative:

- Only 31 contractors out of more than 200, or less than 15 percent, submitted any VECPs in FY 1969.
- Only 8 contractors submitted 10 or more VECPs.
- Several of our largest contractors submitted no VECPs during FY 1969.
- It is estimated that less than 20 percent of our contractors have ever submitted a VECP.

I could go on, but the evidence is clear. Where we get participation, we realize savings and there is every indication that the potential for increased participation is very real indeed.

It is not enough, of course, to just state we are going to get more VECPs and more savings. We must examine those factors which, to now, have tended to retard the program, and find ways to overcome them. At the same time, we must seek together new applications of value engineering and broaden the program even as we consolidate our gains.

If it is to be successful, value engineering must have the support of top management. This is true as far as it goes which, unfortunately, is not far enough. At no place has value engineering had more support from the top than in the Defense Department and yet, as indicated by the Logistics Management Institute and General Accounting Office reports, success is not complete. One problem lies in a general resistance to change even where the concept is accepted.

If the attitude is one of resistance to change, value engineering cannot thrive. It is a positive management attitude we need for a successful value engineering program; an attitude which accepts not only the concept of value engineering, but also the inevitability of the change which will result, the need for change, if we are to have progress, and the acceptance of the turmoil and controversy which may come from change as the price for that progress.

Sharing Arrangement Not Understood

At the risk of being quoted out of context by the adversaries of the so-called "military-industrial complex," I would like to observe that sharing arrangements inherent in value engineering contract provisions effectively put the Air Force and the contractor into partnership. But, as in all partnerships, the partners must contribute to the accomplishment of some common objective and, if they are successful, both should benefit. The objective in this instance is to find a way other than that specified in the contract to perform or provide some required function for a lesser total cost. The elements which contribute to this partnership are generally as follows:

- The Air Force must assure that the incentives in the value engineering clause are adequate to motivate the contractor.
- The contractor must take the initiative in generating and submitting properly prepared VECPs.
- The Air Force must give VECPs objective and expeditious evaluation and communicate to the contractor the decisions.
- For those proposals approved, the contractor must be compensated in accordance with the terms of his contract.

Sounds simple, doesn't it? Unfortunately, like many things that appear simple, it is exceedingly complex. Let us just look at these "partnership contributions" one at a time.

First, the Air Force must assure that the incentives in the value engineering clause are adequate to motivate the contractor. Since provision for value engineering was first incorporated into the Armed Services Procurement Regulation (ASPR) in 1962, it has been substantially revised three times. The most recent of these revisions is dated June 1, 1967. Each revision broadened the areas in which value engineering could be applied contractually, improved the opportunities for the contractor to share in the savings which result from his efforts, and reiterated the DOD support for the program. And yet, as we noted, savings resulting from the program have not increased at a much greater rate than have defense expenditures and contracts with value engineering clauses. It would seem that either the incentives are not adequate, they are not being properly applied, or they are not properly understood.

We are inclined to discount the first explanation—that incentives are not adequate—if for no other reason than that the response by some contractors *is* proof to the contrary. Data furnished the Logistics Management In-

stitute for its study by five contractors indicated that they were realizing a return on their value engineering investment ranging from 6:1 to 21:1, with the average being somewhat more than 10:1. The LMI study did recommend, however, that DOD closely monitor experience and problems under current ASPR value engineering provisions and make timely corrective revisions, as necessary, to maintain strong motivation for industry VECP activity. This, from an Air Force standpoint, we intend to do.

With regard to the second possible explanation—that value engineering incentives are not being properly applied—contractors have been consistently critical of DOD "customer" attitude in the area of contract negotiations concerning value engineering incentive clauses.

As stated in the LMI report, contractor personnel assert:

- They have often been unable to negotiate a value engineering clause.
- They have had difficulty in negotiating clauses providing for contractor sharing of future acquisition value engineering saving.
- The contractor sharing percentages which they are able to negotiate are often not in line with DOD policy.

While there was probably justification for these assertions early in the program, they continue even after the causes have, for the most part, been corrected. Frankly, they begin to have the hollow sound of excuses.

Consider these facts from the LMI report:

- The dollar value of DOD contracts containing value engineering clauses rose from $3.3 billion in FY 1963 to $22.5 billion in FY 1967.
- As a percentage of total DOD procurement, contracts with value engineering clauses rose from 12.6 percent in FY 1963 to 57.3 percent in FY 1967.
- Examination of FY 1967 contracts with value engineering clauses indicates that contract negotiators in DOD are including value engineering clauses in the major dollar portion of their contracts; and are negotiating value engineering clauses providing not only for contractor sharing of instant contract, but also future acquisition and collateral savings.
- On the contracts examined by LMI, the sharing features fit squarely within the "norms" of the Armed Services Procurement Regulation.

LMI concluded, "We found no support for a claim that this area of value engineering clause contract negotiations is a general problem, although there may have been specific instances in the past where industry criticism was justified."

The evidence and the conclusions notwithstanding, in the Air Force, we will continue to watch this area closely to assure that our contracting officers and negotiators comply with the intent, as well as the letter, of the ASPR. At any rate, we do not find evidence that the lack of application of value engineering incentives is a serious problem at this time.

The third explanation for the lack of response to value engineering incentives was that they were not understood. Again referring to the LMI report, it found that:

- Top industry management does not always fully understand the intent and objectives of the DOD VECP program and, consequently sometimes fails to give its full support. Where top management does fully understand the program's objectives, we usually find aggressive, successful contractor VECP programs.
- Where contractors focus their attention on the "savings sharing" potential to themselves from the DOD VECP program, and relate these shares to augmentation of their income and to return on their value engineering investment, we found top management support was usually not a problem.
- Some contract administration and comptroller personnel in defense industry do not fully understand the intent and objectives of the DOD VECP program and, consequently, fail to pursue it aggressively and fail to give proper visibility to industry benefits realized from the program.

It would not be realistic to draw any conclusions from these general findings. It does seem evident, however, that the failure of value engineering incentives to do the job can be more clearly attributed to the fact that they are not understood, rather than to either a lack of adequacy or a lack of application.

This undoubtedly has a bearing on the second element of our partnership, which was that the contractor must take the initiative in generating and submitting VECPs. If the incentives are not understood, it would follow that the contractor would not be motivated to submit VECPs.

We Want a Professional Effort

The submission of VECPs by the contractor is voluntary. If the program is to experience the growth which we see for it, contractor management, from top down, must become enlightened. This must be followed up with positive and aggressive action.

Don't misunderstand me. We do not just want VECPs. We want a professional effort.

VECPs should have the same care and thoroughness in preparation as any other industry proposal to a customer. The LMI study recommended greater industry emphasis on such matters as:

- Reduction of length of VECP processing time within industry itself.
- Improvement of the quality of industry VECPs with more complete supporting technical information and cost analysis.
- Establishment of early and continuing VECP communications channels with DOD counterparts.

I would like to add to these some recommendations of my own for our industry partners.

> **First, take a look at your Value Engineering Program and, if it needs it, revitalize it. Make sure it is an organized effort and that it has your support in attitude, as well as support in concept. Make sure it is not concentrating in the cost reduction area to the exclusion of the more difficult, but profitable, VECP. Establish goals for your Value Engineering program and follow through—not goals on numbers of VECPs, but goals on dollars accruing to you.**
>
> **Second, look for ways to expand the application of value engineering to your advantage.**
>
> **For example, do you have a Value Engineering Program for your subcontractors? You stand to benefit from their efforts. The evidence is that very few contractors are giving this aspect of the program the attention it deserves.**

It is not my intention to gloss over the part the Air Force plays in the submission of VECPs. In addition to the motivation provided by the incentives, the Air Force must demonstrate by its actions that it is receptive if we are to succeed. This is the third element of the partnership: that the Air Force must give VECPs objective and

expeditious evaluation and communicate to the contractor its determination.

To quote from the LMI report: "The belief of many in defense industry that their DOD 'customer' attitude is often out of step with the intent of the DOD VECP program is a general problem and *may be the most serious single current impediment* to more aggressive defense industry VECP activity." It was the LMI conclusion that "defense industry will increase its VECP activity significantly when it is generally convinced that its DOD 'customer'—at all levels of Defense Department—is receptive to industry initiated VECPs."

Further, the major industry criticisms, as reported by the LMI, in the VECP processing area were:

- Too many industry VECPs are disapproved by DOD.
- Too many industry VECPs are in the hands of DOD for "excessively long" times before being approved or disapproved.
- Too many industry VECPs are disapproved with no reasons or with only cryptic reasons for disapproval furnished the submitting contractor.
- Contractors are not given an opportunity to correct defective VECPs so that they can be approved.
- "Feedback" information to industry from DOD on the status of its VECPs is generally inadequate.

Although these are criticisms against DOD, the Air Force readily admits its share of the responsibility. As these and other problems are identified, we take action to overcome them.

Pertinent to the criticism that too many VECPs are disapproved, we want approved VECPs because approvals mean savings. Of course, the VECP must be adequately prepared and properly supported, which is the responsibility of the contractor. But the Air Force must assure that those with merit are not disapproved because of an anti-change attitude or some other insufficient reason.

We maintain management visibility in this area by requiring a report stating the reasons for disapproval on any VECP on which the savings are estimated to exceed $50,000. Each succeeding level of management, through DOD, has an opportunity to question the judgment of the disapproving organization. Although this does not solve all our problems in this area, it does tend to inhibit capricious disapproval actions.

As far as processing time on VECPs is concerned, we in the Air Force are making progress. A "bench mark" of 60 calendar days processing time from submission by the contractor to approval or disapproval by the contracting agency has been established by DOD. Each of the Departments has accepted a goal stated in terms of a percentage of VECPs received which will be processed in no more than 60 days. The Air Force goal, which is by far the most stringent of any of the DOD organizations, is that 77 percent of all VECPs must be processed within 60 days. In FY 1969, we made this goal.

In the area of communications, where it is alleged that the reasons given for disapprovals are not adequate or "feedback" is deficient, we will continue to strive for improvement.

We in the Air Force will continue to seek ways to create a more positive climate for the reception of VECPs. We are sensitive to the charge that a negative "customer" attitude may be the most serious single impediment to industry VECP submissions. We intend to demonstrate that we are "in step" with the intent of the VECP program.

The fourth and last element of our industry-Air Force partnership is that the contractor must be compensated in accordance with the terms of his contract. I mention this only because there have been reported instances within DOD when VECPs have been disapproved, and then processed as engineering change proposals, depriving the contractor of the opportunity to share.

Also, there are reported instances where subsequent to the submission and approval of a VECP, attempts were made to negotiate sharing arrangements less favorable to the contractor than those contractually specified.

These, or any similar actions, are contrary to the intent of the VECP program and will be dealt with positively if they come to our attention.

In conclusion, I hope I have answered the question as to whether the Air Force really wants value engineering. If you had doubts, I hope these doubts have been dispelled. I want to leave you with the impression that the Air Force is far from satisfied with our VECP progress to date. We are not here to take comfort in our past accomplishments, but to dedicate ourselves to an even greater effort.

We must face the fact that there are forces inherent in the Air Force and industry which work against the achievement of our objectives. It is our collective management responsibility, through the demonstration of a positive attitude, to counteract these negative forces.

I am confident that the Air Force, in partnership with industry, and to our mutual benefit, will find the way to give the VECP program new and vigorous life. Your success, to date, is simply a prologue to the accelerated efforts you will be called upon to make in the coming years. For what we know now about the potential of value engineering indicates we have a long way to go in exploiting it.

Modular Combat Radio Proposed by Army

A modular tactical radio communication system, adaptable to different combat needs, has been proposed by the Army Combat Developments Command (CDC), Fort Belvoir, Va. The system would take advantage of technological advances in microelectronics to reduce costs and logistic support problems through the development of common-use modules.

As envisioned by CDC, the system would consist of a family of interchangeable common units, elements, modules, or subassemblies, providing numerous configurations to meet specific mission requirements of various users, including aircraft, vehicles and manpacks.

To reduce or eliminate enemy interference, countermeasures actions and frequency allocation problems, each radio configuration would possess only those capabilities necessary to meet normal communications needs.

High reliability and low failure rates would provide the system with average trouble-free, in-service periods of years rather than just days or weeks. Equipment would then be scheduled for replacement at the end of specified periods of time.

According to CDC, configurations or major assemblies could consist of replaceable modules with cost and reliability levels permitting disposal-on-failure as more efficient and economical than module repair.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Lt. Gen. Arthur W. Oberbeck, USA, has assumed the position of Dir., Weapons Systems Evaluation Group, Office of the Dir. of Defense Research and Engineering.

Hugh McCullough is the new Special Asst. to the Asst. Secretary of Defense (Installations and Logistics).

Maj. Gen. Thomas H. Scott Jr., USA, has succeeded **Maj. Gen. Robert C. Kyser, USA,** as Dep. Dir., Defense Supply Agency, Cameron Station, Alexandria, Va. Maj. Gen. Kyser has retired.

Rear Adm. Fowler W. Martin, SC, USN, is now Commander, Defense Electronics Supply Center, Dayton, Ohio.

DEPARTMENT OF THE ARMY

Maj. Gen. George W. Casey has left the Combat Arms Group, Combat Developments Command, Fort Leavenworth, Kan., for duty in Vietnam as Asst. Commander, 1st Cavalry Division (Airmobile)

Col. Ernest Graves Jr. is the new Dep. Dir. of Military Construction, Office of the Chief of Engineers, Washington, D.C.

Col. Carroll N. LeTellier has succeeded **Col. Edwin R. Decker** as District Engineer, St. Louis District, Corps of Engineers, St. Louis, Mo.

Col. Charles L. Anderson, USA, has been named Dir. of Terminals, Hq., Military Traffic Management and Terminal Service, Washington, D.C.

DEPARTMENT OF THE NAVY

Rear Adm. James V. Bartlett, CEC, has been assigned dual positions as Vice Commander, Naval Facilities Engineering Command, and Dep. Chief of Civil Engineers of the Navy, Washington, D.C.

Rear Adm. Robert L. Long has been named Dep. Commander for Fleet Maintenance and Logistic Support, Naval Ship Systems Command, Washington, D.C.

Rear Adm. Gerald E. Miller is the new Asst. Dep. Chief of Naval Operations (Air), Washington, D.C.

Rear Adm. Frank H. Price Jr. is now Vice Commander, Naval Ordnance Systems Command, Washington, D.C.

Rear Adm. James H. Smith Jr. has been appointed Commander, Naval Aviation Integrated Logistics Support Center, Patuxent River, Md.

Rear Adm. (designee) Robert C. Gooding is the new Vice Commander, Naval Ship Systems Command, Washington, D.C.

Capt. Donald G. Iselin, CEC, has been named Dep. Commander for Planning, Naval Facilities Engineering Command, Washington, D.C.

Capt. Leslie O. Larson, SC, has been assigned as Dir. of Procurement, Office of Asst. Secretary of the Navy (Installations and Logistics).

DEPARTMENT OF THE AIR FORCE

Maj. Gen. William V. McBridge has assumed duties as Dep. Chief of Staff for Operations, Hq. Military Airlift Command, Scott AFB, Ill. His replacement as Dep. Chief of Staff, Materiel, is **Brig. Gen. Arthur W. Cruikshank Jr.**

Maj. Gen. Paul R. Stoney has assumed command of the Air Force Communications Service, Scott AFB, Ill.

Brig. Gen. Donald F. Blake replaced **Brig. Gen. Harold V. Larson** as Dir, Military Assistance and Sales, Office of the Dep. Chief of Staff, Systems and Logistics, Hq. USAF.

Brig. Gen. Carroll N. Bolender is the new Dep. Dir. of Development, Office of the Dep. Chief of Staff, Research and Development, Hq. USAF.

Brig. Gen. John S. Chandler is now Asst. Dep. Chief of Staff, Systems, Hq. AFSC, Andrews AFB, Md. His former position as Systems Program Dir., F-111 Program, Aeronautical Systems Div., AFSC, Wright-Patterson AFB, Ohio, was filled by **Brig. Gen. Alfred L. Esposito.**

Brig. Gen. Robert E. Hails has been assigned as Dep. Chief of Staff, Maintenance Engineering, Hq. AFLC, Wright-Patterson AFB, Ohio. Also at Hq. AFLC, **Brig. Gen. William A. Jack** is the new Dep. Chief of Staff for Supply.

Col. Howard L. Byerley is now Inspector General for the Air Force Communications Service, Scott AFB, Ill. Also at Hq., AFCS, **Col. Thomas G. Sams** has assumed the duties of Dir., Command and Control, Office of the Dep. Chief of Staff, Operations.

Col. Jack M. MacGregor is the new commander of the Data Systems Design Center, Suitland, Md.

Col. Tipton P. Mott-Smith is the newly assigned Commander, Aero Propulsion Laboratory, AFSC, Wright-Patterson AFS, Ohio.

Col. Robert C. Mathis has taken command of the Rome Air Development Center, AFSC, Griffis AFB, N.Y. He succeeds **Col. George A. Zahn,** who has retired.

Col. Donald J. Seed has been named Chief of Procurement and Production, B-1 System Program Office, Aeronautical Systems Div., AFSC, Wright-Patterson AFB, Ohio.

Defense Industry Bulletin Gets New Editor

Lt. Col. Matthew W. Irvin, USA, editor of the *Defense Industry Bulletin* since September 1968, has retired from the Army, as of October 31, 1969, after 26 years of service.

The acting editor of the *Bulletin* is now **Capt. Frank W. Kafer, USAF,** associate editor since joining the staff in February 1968.

Army Seeks Flying Gas Tank

Combat Developments Command, Ft. Belvoir, Va., proposes to use Army cargo and utility aircraft as flying tanks for fuel, oil and lubricants for units operating in forward operating areas. Consisting of 500 gallon containers, the system should be able to pump 400 gallons a minute through four hoses.

HEADQUARTERS, DEPARTMENT OF

Editor's Note: Organization charts appearing in the Bulletin are edited by the staff to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizations not involved in the DOD industry relationship have been eliminated because of space limitations.

The information on personnel and telephone extension numbers is as current as is possible to obtain at the time we go to press.

ADMINISTRATIVE ASSISTANT
Mr John G Connell, Jr 3E732 52442
Mr R M Vingling (Deputy) 3E741 55879

GENERAL COUNSEL AND SP ASST FOR CIVIL FUNCTIONS
Mr Robert E Jordan, III 2E614 79235
Mr R Kenly Webster (Deputy) 2E614 74607

DEPUTY UNDER SECRETARY (Operations Research)
Dr Wilbur B Payne 2E727 50083
Mr Abraham Golub (Asst Deputy) 2E727 76742

ASA (Financial Management)
Honorable Eugene M Becker 2E678 54291
Mr Richard L Sainsing (Deputy) 2E678 78121
Col Hugh J Bartley (Executive) 2E678 75215

ASA (Research and Development)
Mr Charles L Poor (Act) 3E390 56133
Dr Jacob B Gilstein (Deputy for Ballistic Missile Defense) 3E365 73558
Dr K C Emerson (Act Deputy) (Asst for Research) 3E379 57674
Col Robert K Moore (Executive) 3E390 55749

ASA
Honorable William K
Mr Arthur W Allen, Jr (Pers Mgt & Trg)
Col James W

General W C Westmoreland

General Bruce Palmer, Jr

THE JUDGE ADVOCATE GENERAL
The Judge Advocate General
MG Kenneth J Hodson 2E444 75191
The Asst Judge Advocate General
MG Lawrence J Fuller 2E444 76306
Executive
Col T H Pease 2E444 54304

THE INSPECTOR GENERAL
(Forrestal Building)
The Inspector General
MG W A Enemark 5A013 35174
Deputy The Inspector General
BG A R Brownfield 5A013 35172
Executive
Col Gustav M Bacharach 5A013 35170

DIR FOR CIVIL DISTURBANCE PLANNING AND OPERATIONS
LTG W T Kerwin, Jr BF751B 73147

SAFEGUARD SYSTEM MANAGER
LTG A D Starbird (SAFSM)

DIRECTOR MANAGEMENT INFORMATION SYSTEMS
BG H C Schrader (Dir) 1D269 50678
Col E L Valenstein (Dep Dir) 1D629 30040
LTC L D Pence (Exec) 1D629 75503

DIRECTOR FORCE PLANNING ANALYSIS
BG J L Baldwin (Dir) 3C718 54617
Col R E Pfeil (Dep Dir) 3C718 71475
LTC G F Newton (Exec) 3C720 75628

DIRECTOR WEAPON SYSTEMS ANALYSIS
Mr R J Trainor (Dir) 1E600
Col A W Jones (Dep Dir) 1E600
Maj W L Hatcher (Exec) 1E608

COMPTROLLER OF THE ARMY
Comptroller of the Army
LTG Frank J Sackton 3A716 52510
Deputy Comptroller
Mr Eckhard Bennewitz 3A720 76659
Executive
Col J A Kjellstrom 3A712 72027

ASSISTANT CHIEF OF STAFF FOR INTELLIGENCE
ACofS for Intelligence
MG J A McChristian 2E464 53033
Executive
LTC R H Groover, Jr 2E464 52968
Dep for Intelligence Support
BG V J Fenili 2E464 53929
Dep for Intelligence
BG D C Armstrong, III 2E474 72577

DEPUTY CHIEF OF STAFF FOR MILITARY OPERATIONS
Dep CofS for Mil Operations
LTG Richard G Stillwell 3E648 52904
Asst Dep CofS for Mil Ops
MG R T Knowles 3E634 75180
Executive
Col A A Olson 3E648 74521
Dir of Operations
MG W R Desobry 3E538 53310
Dir of Plans
MG G H Woodward 3E530 55032
Dir of Intl & Civil Affairs
BG A E Milloy 3A526 59084

DEPUTY CHIEF OF STAFF FOR PERSONNEL
Dep CofS for Personnel
LTG Walter T Kerwin 2E736 56003
Asst Dep CofS for Pers
MG W E Brinker 2E736 52250
Executive
Col F E Blazey 2E733B 78060

DEPUTY CHIEF OF STAFF
Dep CofS for Log
LTG Joseph M
Asst DCofS for Log
MG F D Miller
Executive
LTC R W Patterson
Director of Mat Acq
Col C M McKeen
Director of Plans
BG J G Appel
Director of Supply
Col W D Pardue
Col E F Buesch
& Commonwealth B
1320 Wilson Blvd.

CHIEF, U.S. ARMY AUDIT AGENCY
(Nassif Building)
Chief
MG Herbert G Sparrow 436 22730
Deputy Chief
Mr William Bishop 436 22830
Exec Off
Col J B Bonham 436 22855

CHIEF OF MILITARY HISTORY
(Temp Bldg C, 2nd and R Sts, SW)
Chief
BG H C Pattison 2003 52064
Deputy Chief
Col H A Schmidt 2007 52017

CHIEF OF ENGINEERS
(Temp Bldg T-7, Gravelly Point)
Chief of Engineers
LTG Frederick J Clarke 1127 53062
Deputy Chief of Engineers
MG Carroll H Dunn 1223 55463
Executive
Col Philip T Boerger 1228 73414

CHIEF OF PERSONNEL OPERATIONS
Chief of Personnel Operations
MG F W Boye, Jr 1E732 56730
Deputy Chief of Personnel Operations
BG R A Edwards, Jr 1E736 74337
Executive Officer
Col W M Turner 1E734 59728

THE ADJUTANT GENERAL
The Adjutant General
MG Kenneth G Wickham 2E532 50163
Asst The Adjutant General
Col C A Stanfiel 2E532 50163
Executive Officer
Col Donald L Geer 2E532 50163

CHIEF
Chief of Chaplains
CH (MG) Francis L Sa

ARMY CHIEFS AND EXECUTIVES

AY
3E718 53?11
3E718 53?11
3E718 53?11

ARMY
2E722 5911
2E722 7606
2E722 5247

DEPUTY UNDER SECRETARY (International Affairs)

Mr James V Siena	3E736	72241
Col Lawrence M Jones (Executive)	3E736	72432

Affairs)
2E594 7953
2E594 5594
2E591 71167

ASA (Installations and Logistics)

Honorable J Ronald Fox	3E606	52254
Mr Vincent P Huggard (Deputy)	3E616	59600
Col Niklias C Manitsas (Executive)	3E606	52216

DIRECTOR OF CIVIL DEFENSE

Mr John E Davis	3E346	74484
Mr Hubert A Schon (Deputy Director for Operations)	3E336	59384
Mr Robert E Young (Executive Asst)	3E346	53374

W B Steele (Exec) 3E668 52110
F
E P Forrester (Exec) 3E668 54371
F STAFF
D656 50294

ADVANCED AERIAL FIRE SUPPORT SYSTEM MANAGER

MG J L Klingenhagen (MGR) 1B464 53060

STANO SYSTEMS OFFICE

BG W B Fulton 3C637 50022

AL STAFF
3E668 53342

EP SECRETARY OF THE GEN STAFF (Staff Services)

Hamblen, Jr (DSGS)	3E669	52776
e House LNO)		

DEP SECRETARY OF THE GEN STAFF (Staff Action Control)

Col J G Hill, Jr (DSGS)	3E665	57552

DEP SECRETARY OF THE GEN STAFF (Coordination and Reports)

Col T M Tarpley (DSGS)	3D643	73206

CHIEF OF PUBLIC INFORMATION

Chief		
MG Wendell J Coats	2E636	55135

CHIEF OF LEGISLATIVE LIAISON

MG William A Becker (Chief)	2C631	76767

CHIEF OF INFORMATION

Chief of Information		
MG Wendell J Coats	2E636	53135
Deputy Chief		
Vacancy	2E636	74482
Executive		
Col L E Stanford	2E636	74200
Asst CInfo (Plcy & Op)		
Col L Breault	2E646	74359
Asst CInfo (Plans & Prog)		
Col F Petruzel	2E646	74269
Policy & Plans Div		
Col E C Raleigh	2E637	73447
Comm Rel Div		
Col Robert W Leonard	2E631	75716
Public Information Div		
Col W Schabacker	2E641	55136

ARMY RESERVE FORCES POLICY COMMITTEE

Chairman		
MG Stuart D Menist	3B747	73391
Subcommittee on Army National Guard Plcy		
MG Henry W McMillan (Chairman)	3B747	73391
Subcommittee on Army Reserve Policy		
MG Stuart D Menist (Chairman)	3B747	74369

LOGISTICS

3E560	54102
3E560	75301
3E560	79039
503A&	44391
3E576	74?44
1E550	70973
2C567	53?22
3C565	50?10
2E572	74221
1E558	52661
6318&	44300

Va.

ASSISTANT CHIEF OF STAFF FOR FORCE DEVELOPMENT

ACofs for Force Development		
LTG A S Collins, Jr	3E468	55775
Dep ACofs for Force Dev		
MG R R Williams	3E468	75584
Executive		
Col W T Moseley	3E468	55703
Dir of Air Defense		
BG C J LeVan	3E458	70316
Dir of Army Aviation		
MG J L Klingenhagen	3E466	52882
Dir of Cbr & Nuclear Ops		
BG W W Stone Jr	3A480	57728
Dir of Doctrine & Systems		
BG R C Tabor	3E480	75116
Dir of Plans and Programs		
BG G S Blanchard	3E522	56772
Dir of Org Unit Tng & Readiness		
BG T J Camp, Jr	3E452	73725

CHIEF OF RESEARCH AND DEVELOPMENT

Chief of Research & Dev		
LTG A W Betts	3E412	78186
Dep Chief of Rsch & Dev		
MG Edward L Rowny	3E412	78187
Chief Scientist, DA		
Dr M E Lasser	3E424	72612
Executive		
Col W H Tucker, Jr	3E412	54997
Dir/Plans & Programs		
BG D D Blackburn	3E436	56766
Dir/Development		
Col J B Lamb (Actg)	3E374	75063
Dir/Army Research		
Col G M Snead, Jr	3E374	73710
Dir/Missiles and Space		
Col N W Tobey	3E360	72449

CHIEF OFFICE OF RESERVE COMPONENTS

Chief, Ofc of Res Components		
LTG William R Peers	2E524	52786
Deputy Chief		
MG J M Hightower	2E524	56229
Executive		
Col C E Balthis, Jr	2E524	59488

ASSISTANT CHIEF OF STAFF FOR COMMUNICATIONS ELECTRONICS

Acofs for Comm Elct		
MG G E Pickett	2E258	56604
Dep Acofs for Comm Elct		
BG E R Reynolds	2E254	57070
Executive		
Col J M Templeman	2E258	72180
Dir Plans & Programs		
Col H E Porter	2E261	53355
Dir Army Telecommunications		
Col M M Berry	17-A#	53196
Dir Tactical Systems		
Col E S King	26-D#	52344
Dir Frequency Management		
Col T N Oeppner	33-A#	52903

Greely Building
2100 14th St. N, Arlington, Va.

CHIEF OF SUPPORT SERVICES
(Temp Bldg A, 2nd and R Sts, SW)

ief of Support Services		
ol D F Munster	2043A	75017
uty Chief		
ol Vincent L Corrado	2047A	75029

CHIEF NATIONAL GUARD BUREAU

Chief, National Guard Bureau		
MG W P Wilson	2E394	59265
Deputy Chief		
MG F S Greenlief	2E394	75559
Executive		
Col Joseph R Jelinek	2E394	56701

CHIEF, ARMY RESERVE

Chief, Army Reserve		
MG W J Sutton	2E516	71784
Deputy Chief		
Col L W Fritter	2E516	71260
Executive Officer		
Col J F Kettler	2E516	54733

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)
6B158 35221

THE PROVOST MARSHAL GENERAL
(Forrestal Building)

The Provost Marshal General		
MG K W Gustafson	5A157	35109
Deputy		
Col J C Shoultz, Jr	5A157	35120
Executive		
LTC Frederick L Gemmer	5A157	35121

THE SURGEON GENERAL
(Main Navy Building)

The Surgeon General		
LTG L D Heaton, MC	2056	63335
Deputy Surgeon General		
BG H B Jennings, Jr, MC	2056	64112
Executive Officer		
Col R P Campbell, MC	2066	63122

VECPs Save $84 Million in FY 1969

The Defense Department accepted 1,221 contractor Value Engineering Change Proposals (VECPs) during FY 1969, reducing Defense contract costs more than $84 million, according to the Office of the Assistant Secretary of Defense (Installations and Logistics). Through the value engineering clause in their contracts, the companies' shares of savings varied from 20 to 60 percent. The following companies had Hi-Dollar VECPs (net savings of at least $50,000 before value engineering sharing) accepted during FY 1969:

Aerojet General Corp.; Aircraft Armaments, Inc.; American Electric and Machine Co., Inc.; Apex Metal Stamping Co., Inc.; API Instruments Co.; ARF Products, Inc.; Aseco, Inc.; AVCO Corp.; Bell and Howell Co., Inc.; Bendix Corp.; The Boeing Co., Inc.; Bowen-McLaughlin-York, Inc.; Bulova Watch Co., Inc.; Burroughs Corp.

Caterpillar Tractor Co., Inc.; Chamberlain Corp.; Condec Corp.; Continental Aviation and Engineering Corp.; Crowell Constructors, Inc.; Cullman Metalcraft; Daily Tube and Form Co., Inc.; Day and Zimmerman, Inc.; Eastern Tool and Manufacturing Co.; EG&G, Inc.; Fairchild Hiller Corp.; Fruin-Colmon Contracting Co.

Galion Amco, Inc.; Garrett Corp.; F. W. Gartner Co.; General Dynamics Corp.; General Electric Co.; G.G. Green Inc.; Goodyear Aerospace Co., Inc.; Grumman Aircraft Engineering Corp.; Hayes International Corp.; Hercules, Inc.; Hochtief AG; Honeywell, Inc.; Hughes Aircraft Co.; Kaiser Jeep Corp.; Kennedy Van Saun Manufacturing and Engineering Corp.

Lasko Metal Products; Litton Industries Inc.; Lockheed Aircraft Corp.; LTV, Inc.; Magnavox Co.; Martec, Inc.; Martin-Marietta Corp.; Melpar, Inc.; North American Rockwell Corp.; Northrop Corp.; Ocean Products, Inc.; Olin Mathieson Chemical Co.; Philco-Ford Corp.; Raytheon Co.; RCA Corp.; R.C. Can Co.; REDM Corp.; Reflectone, Inc.; Rubber Fabricators, Inc.

Sanders Associates, Inc.; Sargeant-Fletcher Co.; Sperry Rand Corp.; Tacoma Boatbuilding Co., Inc.; Textron, Inc.; Thompson Aircraft Tire Corp.; United Aircraft Corp.; Westinghouse Electric Corp.; Wythe Tool and Machine, Inc.; Yankee Hill Machine Co.; Zenith Radio Corp.

Navy RDT&E Guide Available

The third edition of the "Research, Development, Test and Evaluation Management Guide," published by the Assistant Secretary of the Navy (Research and Development), is now available.

Identified as NAVSO P-2457, copies are $2.50 each from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Revised Edition of ITAR Available

The regulations on International Traffic in Arms (ITAR) have been revised by the Department of State. The publication includes excerpts from the Mutual Security Act of 195 (as amended), Executive Order 10973 "Administration of Foreign Assistance and Related Functions," and Executive Order 11432, "Control of Arms Imports."

The August 1969 edition of the regulations, of interest to industry concerned with commercial exports of arms, ammunition, military equipment, and technical data relating thereto, is available without charge from the Office of Munitions Control, Department of State, Washington, D.C. 20520.

Contractor Retention of Classified Material

The Office of Industrial Security, Defense Supply Agency, reports that occasionally, during recurring inspections of contractor facilities, it has been discovered that a contractor is retaining certain classified information without proper authority. When retention of such material would materially assist the contractor in his performance on other government contracts, he may request authority to retain the material in accordance with paragraph 51 of the Industrial Security Manual (ISM) for Safeguarding Classified Information (Attachment to DD Form 441).

In several instances, contractors have stated that they had a valid need for retention of certain classified material and had actually requested necessary authority, but had been unable to establish communications with the former contracting officer to obtain the authority. Because of such situations, procedures have been incorporated in Change 2 to the ISM which will enable the contracting officer of a current classified contract to transfer material from a previous contract to the current contract. The revised procedure is intended to ease the problems encountered by contractors in obtaining retention authority when a "need to know" exists, and to assure that the material, which is retained, remains under government cognizance.

Classified material, transferred under these procedures, must be identified as follows:

- Top Secret and Secret material shall be identified in a list of specific documents unless, in the case of Secret documents only, the contracting officer has authorized identification by subject matter and approximate number of documents.
- Confidential material shall be identified by subject matter and approximate number of documents.

This material must also be identified as to its origin. Ultimate disposition or declassification responsibility will remain with its originating agency.

When retention approval is granted the contractor, the current contracting officer will so notify the contracting officer who had previous cognizance over the classified material. If the material involved is the information of a DOD user agency and is being retained by a contractor of a non-DOD user agency, or vice versa, or between non-DOD agencies, the concurrence of the original contracting officer must be obtained by the current contracting officer prior to granting the retention authority.

Application of Medical Knowledge to Operation of Aircraft and Space Vehicles

Major General Charles H. Roadman, USAF

In November 1959, the dream of a few farsighted, research-oriented Air Force medical officers came into reality with the organization of the U.S. Air Force Aerospace Medical Center. Assigned to the Air Training Command and located at Brooks AFB, Tex., the center was the initial step toward placing management of aerospace medical research and development, medical education, and certain clinical medicine practices under one command.

On November 1, 1961, the center was transferred to Air Force Systems Command (AFSC) as the Aerospace Medical Division (AMD). Certain aeromedical research-oriented units, already assigned to AFSC, were transferred to the AMD in early 1962, thus bringing all Air Force-sponsored aerospace medical research and development under the direction of one command. At the same time, AMD retained its educational and clinical medicine missions.

The philosophy behind this threefold mission is that each facet of the total effort supports the other two. It provides a favorable climate for rapid advancement in medical knowledge with wide and prompt dissemination of new concepts into medical and operational practice. Medical research and development account for the largest part of AMD's total effort. Roughly 70 percent of our budget, our physical facilities, and the talents of our professional and technical people is spent on research and development programs.

Clinical practice claims about 20 percent and the balance of 10 percent goes into medical education. Of course, there is a good deal of interchange in personnel and equipment among the three missions. The research people do some teaching and they may also participate in medical practice, particularly in connection with experimental programs. Clinical personnel do research and teaching, and the teaching staff engages in medical practice and research efforts.

The proportion of AMD's total effort, assigned to any one facet of the mission, does not necessarily reflect the relative importance of that area to the Air Force or to the nation. The educational function, for example, is the prime source of trained specialists in aerospace medicine, not only for this country but for many of our allies. A great many of the medical officials trained by AMD are now with the airlines, in aerospace industries, and with other government agencies, such as the Federal Aviation Agency and the National Aeronautics and Space Administration (NASA).

To carry out its triple-mission, AMD plans and directs the operation of five facilities at four geographic locations in Ohio, New Mexico and Texas. Each of these facilities has its own commander and their missions reflect the varied aspects of the AMD mission.

Wilford Hall Hospital and Epidemiological Laboratory

Lackland AFB, Tex., some 12 miles from the headquarters of the Aerospace Medical Division at Brooks AFB, Tex., is the home of two AMD units—Wilford Hall USAF Hospital and the U.S. Air Force Epidemiological Laboratory.

Wilford Hall USAF Hospital is the primary clinical component of the division. This 1,100-bed institution is the Air Force's largest hospital and one of two AMD units where all three phases of our mission—education, research and clinical medicine—are carried out. It serves Lackland, the basic training center of the Air Force, as a base hospital and provides medical care for a large local military population. It also serves the Air Force as a referral center for complex diagnostic problems on a worldwide basis. The hospital staff has the capability of performing any of the complicated surgical procedures that are

Major General Charles H. Roadman, USAF, is Commander of the AFSC Aerospace Medical Division. In previous assignments, he served as Command Surgeon for the North American Air Defense Command, and as Director of Aerospace Medicine, Manned Spaceflight, with the National Aeronautics and Space Administration. General Roadman earned a Bachelor of Science degree from Dakota Wesleyan University, and Bachelor of Medicine and Doctor of Medicine degrees from Northwestern University Medical School.

performed in most major medical centers, including kidney transplants and open heart surgery. It is the only Air Force hospital with a program for the treatment of chronic kidney ailments using the artificial kidney and, as the cancer treatment center for the Air Force, Wilford Hall maintains the central tumor registry.

This facility presently has the case histories of over 18,000 cancer patients in computer memory banks with more added each day. The computers can quickly identify the type of cancer and greatly expedite treatment procedures by rapidly identifying the most successful mode of treatment in past cases. "Big Willie," as the hospital has come to be known, has two other Air Force-wide missions. It is the sight and hearing center of the Air Force and, as such, is the home of the Air Force Central Eye Bank. From this facility fresh ocular tissue can be shipped to other Air Force medical facilities as required.

In the education portion of AMD's mission, Wilford Hall conducts over 40 medical education courses. These are primarily postgraduate training in the form of internships in medicine and dentistry, and residency training in 18 medical, surgical and dental specialties, plus hospital administration. Fellowships in 11 subspecialties are also available at Wilford Hall, the only Air Force hospital with a fellowship program.

The U.S. Air Force Epidemiological Laboratory, also located at Lackland AFB, is responsible for the investigation of epidemics that might pose a threat to Air Force personnel any place in the world. In 1966 this organization was instrumental in preventing an epidemic of meningitis among basic training students at Lackland. Early identification of the specific meningitis bacteria assisted the medical staff at Wilford Hall Hospital in treatment and enabled initiation of early preventive measures that halted the epidemic.

Aerospace Medical Research Laboratory

At Wright-Patterson AFB, Ohio, in our Aerospace Medical Research Laboratory (AMRL), research is conducted in the fields of toxicology, biomechanics, human engineering and life support. Founded 34 years ago primarily to fabricate and test new flying safety devices and systems for the protection of man in high-speed aircraft, this laboratory now represents a capability in man and equipment not duplicated anywhere in the free world.

Toxic hazard studies have been underway at AMRL for a number of years. These studies utilize a group of space cabin simulators known as "Thomas Domes." In one study all of the material to be used in the Apollo spacecraft was ground up and heated to out-gas into the chambers where laboratory animals were exposed. Object of the study was to determine what effect the trace contaminants might have on the animal's ability to perform. Studies of this nature can be conducted for any prescribed period of time, and a fall-out benefit of this and similar studies in the past is expected to be an increased knowledge of the effect of air pollution on urban population centers.

On a specially constructed vibration couch at AMRL, various frequency vibrations are produced to study their effect on man's ability to perform. In the early Titan missiles, fuel sloshing around in the tanks set up pogo vibration at lift-off. AMRL scientists, by producing this same vibration on the couch, were able to determine that these vibrations, though they posed no physical threats to our astronauts, would prevent them from performing necessary tasks during the critical period of lift-off. As a result of these studies, the Tital fuel system was redesigned and the pogo effect eliminated. Recently, this couch has been used to study some of the vibrations expected to be encountered in supersonic flight at low levels.

Aeromedical Laboratory

At Holloman AFB, N.M., the division's Aeromedical Research Laboratory maintains a large research animal colony. Here Rhesus monkeys and chimpanzees are taught to perform discrete tasks, while base-line data is kept on the individual animals and the species. This provides laboratory

THOMAS DOMES at the 6570th Aerospace Medical Research Laboratory are used to study toxic hazards from space capsule materials that might threaten man's safety during flight.

scientists excellent subjects for use in those experiments not feasible for the human volunteer.

The possibility of damage to a spacecraft in flight has raised the question of emergency procedures after an explosive decompression. Our concern is not only with the time of useful consciousness, but more specifically with the time available to save the crewman's life and to prevent permanent brain injury.

At the Holloman laboratory, trained chimpanzees have been exposed to a near vacuum for as long as three and one-half minutes. After recompression and with a four-hour recovery period, the animals performed at a level consistent with their capability before exposure. The exposure time of three and one-half minutes cannot be extrapolated directly to human beings, but we do know that man can withstand a much longer exposure than had previously been thought possible.

Human reaction to linear deceleration is of particular interest to scientists at Holloman. On the Daisy track, where a sled propelled down the track by compressed air is braked to a pre-programmed stop by water brakes, several studies have been conducted on man's limits in exposure to impact. Some of the more recent studies on the Daisy track have been the testing of the seat belt restraint mechanisms for the F-111 aircraft and the Apollo spacecraft.

School of Aerospace Medicine

The U.S. Air Force School of Aerospace Medicine is located with division headquarters at Brooks AFB, Tex. This organization was activated in 1917 as the Aviation Medicine Laboratory at Mineola, N.Y. The history and progress of the School of Aerospace Medicine from its activation is in a real sense the history and progress of aerospace medicine.

In 1949, several years before Sputnik, the school organized the first department of space medicine in the free world. Since that time it has played a key role in research in space cabin atmospheres, radiation hazards, disorientation, space nutrition, and a variety of other problems encountered in aerospace operations. The school conducts over 30 courses in specialized training that vary in length from three days to three years.

In the clinical medicine portion of our mission, the school's Aeromedical Consultation Service is responsible for the initial medical evaluation of NASA's prospective astronauts and the Air Force's aerospace test pilots. Similar medical evaluations are performed on personnel for a number of government agencies.

Because of this ability to accomplish very detailed medical evaluations, the school established a referral service for flying personnel several years ago. Anytime an air crew member's fitness for flying is questioned and it cannot be resolved at his home base, he is referred to the school for examination and evaluation. Nearly 50 percent of these questionable cases are returned to flying status after thorough, detailed medical evaluations. This program has resulted in potential savings to the taxpayer of well over $300 million in the past eight years.

Another example of systems-oriented work conducted by AMD organizations is the research on habitable atmospheres for space cabins at the School of Aerospace Medicine. These studies have been performed for NASA in validating the Gemini-Apollo cabin environments, and to validate atmospheres for planned Air Force space flight including the Air Force space flight.

Studies completed under this program indicate that no ill effects result from the use of an atmosphere composed of 70-percent oxygen and 30-percent helium at a pressure of five pounds per square inch. Other atmospheric studies have been with 100-percent oxygen, and mixtures of oxygen and nitrogen. As a result of these studies, we are now able to offer systems designers a choice of several cabin environments that will not impair the ability of astronauts to function.

In addition to specific mission achievements, AMD has made a concerted effort to support our forces in Southeast Asia. Besides providing trained medical personnel to medical facilities in Southeast Asia, AMD research and development personnel have been responsible for a number of items in direct support of combat forces there.

To provide comfort to pilots flying in unventilated aircraft at low altitudes in tropical climates, our researchers adapted a rubberized vest circulating chilled water through tubes from an ice chest, using an electric pump. The vest weighs approximately three pounds and is worn under the flying suit. The weight of the entire unit for two men is less than 50 pounds, including 25 pounds of ice, and it occupies about 1 cubic foot of space. In a humid atmosphere at temperatures of 115 degrees F., it cools two men for a period of two hours.

In 1963, the human engineering people in the laboratory at Wright-Patterson AFB started working on the theory of lateral sighting techniques for aircraft. A modified gunsight was devised from this lateral firing concept and tested in a C-47 aircraft. This led to the development of what we now know as "Puff, the Magic Dragon." Gunship II utilizing a C-130 aircraft and this same lateral firing concept is now in use in Southeast Asia.

Other developments in support of the Vietnam conflict include a new litter rack system for aeromedical evacuation flights on C-141 aircraft. This new development enables medical attendants to draw a litter from its normal flight position while a patient receives whatever care is needed. The litter then slides back and is locked in its regular position.

A second major development in aeromedical evacuation occurred during 1968 when the Air Force accepted the first C-9 aircraft. This is the only aircraft designed specifically for the air evacuation mission of Military Airlift Command and the interior configuration of the aircraft was designed by AMD personnel.

From the early days of aviation, components of the present Aerospace Medical Division have paralleled the extraordinary achievements of aircraft engineers in evolving high-speed, high-alitude flight systems by reconciling them with human needs and limitations. These advances have contributed significantly to the safety and comfort of passengers in modern jet transports. Since World War II the same progress has continued by extension to rocket aircraft and space vehicles. Eventually these innovations will be enjoyed routinely by travelers in supersonic transports, orbital gliders and interplanetary spacecraft. The work that is going on within the Aerospace Medical Division today will play a key role in this development.

Managing Government-Owned Equipment

Captain Hugh D. Byrd, SC, USN

On the organization chart of the Defense Supply Agency (DSA), the Defense Industrial Plant Equipment Center (DIPEC) at Memphis, Tenn., appears to be one of several like major field activities of this logistics agency, devoted to the management of common supplies for the Defense Department.

Such is not the case, however. DIPEC is to DSA as Alaska or Hawaii is to the other 48 states. While alike in many respects, in others DIPEC is startingly different from the other DSA field activities. The principal differences are threefold.

First, the other centers primarily manage expendable, non-recoverable items not requiring maintenance. DIPEC manages expensive end items or equipment which are not expendable and have long life expectancies.

Second, while the other centers deal almost entirely with military activities, many of DIPEC's customers are defense contractors who have been authorized to use government-owned industrial plant equipment (IPE) in connection with a defense production program.

The functional relationships between DSA/DIPEC and the other military components relative to IPE management also differ from the norm.

DIPEC is the logical outgrowth of a program initiated by the Military Departments immediately after the end of World War II. In order to preclude at least part of the difficulty experienced in increasing the national production base to meet defense production needs for World War II, each Military Department selected equipment becoming surplus as a result of the end of the war for retention against future mobilization needs. Within only a few years, the wisdom of this action was clearly demonstrated when the availability of this equipment permitted a much more effective and timely response to the defense production requirements generated as a result of the Korean conflict.

Subsequent to Korea, the Military Departments increased and strengthened their industrial reserve programs under the leadership of the Secretary of Defense. In-use inventories of this equipment were taken and records were established for each item. Reserve stocks developed into two categories. Some items were held in "packages" intended for use in production of specific end items of defense hardware, and others were held in a "general reserve" for application, as needed, to expand the defense production base. These stocks were used also to support current operating requirements so that the inventory would continue on a dynamic basis.

By the early 1960s, the program had grown to the point where it became clear that both management improvements and economies could be achieved by centralizing the program within one activity. DSA was the logical agency for the task and, accordingly, DSA was directed in December 1962 to establish a Defense Industrial Plant Equipment Center. After some nine months of planning, DIPEC became operational on Sept. 1, 1963.

Mission Objectives and Operation

DIPEC's major mission objectives can be summarized as:

- Managing the DOD General Reserve of Industrial Plant Equipment.
- Obtaining maximum reutilization of DOD-owned equipment in order to avoid new procurement wherever feasible.

DIPEC currently has central inventory records on approximately 460,000 individual items of IPE, with a gross acquisition value in excess of $4 billion. As an indication of its activity, DIPEC has, since its inception, obtained reutilization of over 77,000 items of equipment with an acquisition value of approximately $668 million.

The sites at which IPE is stored and maintained for the Services have been reduced from 14 to 4. The four are located throughout the continental United States (Mechanicsburg, Pa.; Columbus, Ohio; Atchison, Kan.; and

Captain Hugh D. Byrd, SC, USN, has been Commander of the Defense Industrial Plant Equipment Center since July 1965. In previous recent assignments, he served as Deputy Commander of the Defense Depot Memphis (Tenn.), and before that as Comptroller at the Boston Naval Shipyard. Capt. Byrd holds a B.S. degree from the University of North Carolina and an M.B.A.

DEFENSE INDUSTRIAL PLANT EQUIPMENT CENTER

MEMPHIS, TENNESSEE, 38102
Phone (901)743-3410

Editor's Note Organization charts appearing in the bulletin are edited to reflect those elements which are of interest to industry representatives. Organizational elements not involved in the DOD-industry relationship are omitted because of space limitations.

Names and telephone numbers are as current as possible at press time.

COMMANDER
Captain Hugh D. Byrd, SC, USN

EXECUTIVE DIRECTOR
Hugh R. Carrington

OFFICE OF PLANNING AND MANAGEMENT
F.A. Morrin, Jr.

- Plans, Programs and Analysis Division
  - P.H. Coons
- Systems, Programming and Procedures Div
  - W.C Wilson
- Procurement Division
  - E.T. Burns
- Management Engineering Division
  - T.H. Tuttle
- Mission Expansion Planning Office
  - W.C. Wilson

OFFICE OF COMPTROLLER
W.R. Miller

- Financial Management Division
  - M.L. Sikes
- Performance Analysis and Reports Division
  - J.T. Lawrence

OFFICE OF INSTALLATION SERVICES
T.E. Suggs

DIRECTORATE OF SUPPLY OPERATIONS
W.A. Wollard

- Management Support Office
  - B.F. Clark
- Metalworking Equipment Division
  - M.E. Smullen
- Electronic and General Plant Equipment Div
  - H.H. Harpel
- Support Division
  - J. Fulton, Jr.
- Storage and Maintenance Division
  - C.L. Moore

DIRECTORATE OF TECHNICAL OPERATIONS
W.M. Payne

- Engineering and Field Services Division
  - L.W. Goar
- Equipment Identification Division
  - R.L Myers

TENANT ACTIVITY

A.F. Supporting Plant Equipment Branch
Headquarters A.F. Contract Management Division (AFSC)
Los Angeles, Calif. 90045

DEFENSE INDUSTRIAL PLANT EQUIPMENT FACILITIES

OPERATIONAL CONTROL	TECHNICAL DIRECTION
Defense Industrial Plant Equipment Facility Atchison, Kansas Fred B. Jensen	DDTC Tracy, Calif. Stockton Annex Lt. Col. G.F. Keyes, USAF DCSC Columbus, Ohio Don Butt DDMP Mechanicsburg, Penna. Ray Stine

Stockton Calif.) in proportionate relationship to the area density of major defense industries who are the customers of DIPEC's services. The reduction to four storage/maintenance sites permitted achievement of significant economies in facility maintenance costs and overhead, as well as making facilities available for other purposes.

In addition, procedures have been standardized and considerable progress has been achieved toward mechanizing many of the DIPEC internal processes on an IBM 360/40 system. Some defense contractors have started to make their inventory reports on either magnetic tape or punched cards. This process, too, has and will reduce costs by avoiding the preparation and transmittal of hard copy products between the contractor's mechanized property record systems and DIPEC's computer-based central inventory records. It is hoped that all contractors, who are currently using significant quantities of DOD-owned IPE and who have mechanized property record systems, will eventually adopt this simple reporting system. The cost savings are significant at both ends.

During the production buildup to meet our defense needs in Vietnam, the demand placed on DIPEC for production equipment (particularly for expensive, long lead-time machine tools) rose by 33 percent. These were some very interesting days, indeed, as DIPEC scurried around to find equipment for some of the really crash programs. For example, the Hydromatic Division of General Motors Corp. had an urgent requirement for equipment to produce the 20mm automatic gun. DIPEC furnished 754 items to this project. The equipment, valued at $8,187,561, constituted a 97.9-percent "fill-rate" on this equipment. On the much publicized M16 rifle program, DIPEC furnished 250 items, valued at $3,487,240.

In both these instances, as on many other projects, much of this expensive equipment would have been purchased new if DIPEC had not been able to make it available from its centralized inventory. These are just two examples, out of thousands, in which DIPEC has been responsive to defense needs—saving all-important ld time as well as dollars. DIPEC successfully met many other priority requirements for support of ammunition, helicopter, vehicular and other end-item hardware programs.

Relationship with Military Departments and Contractors

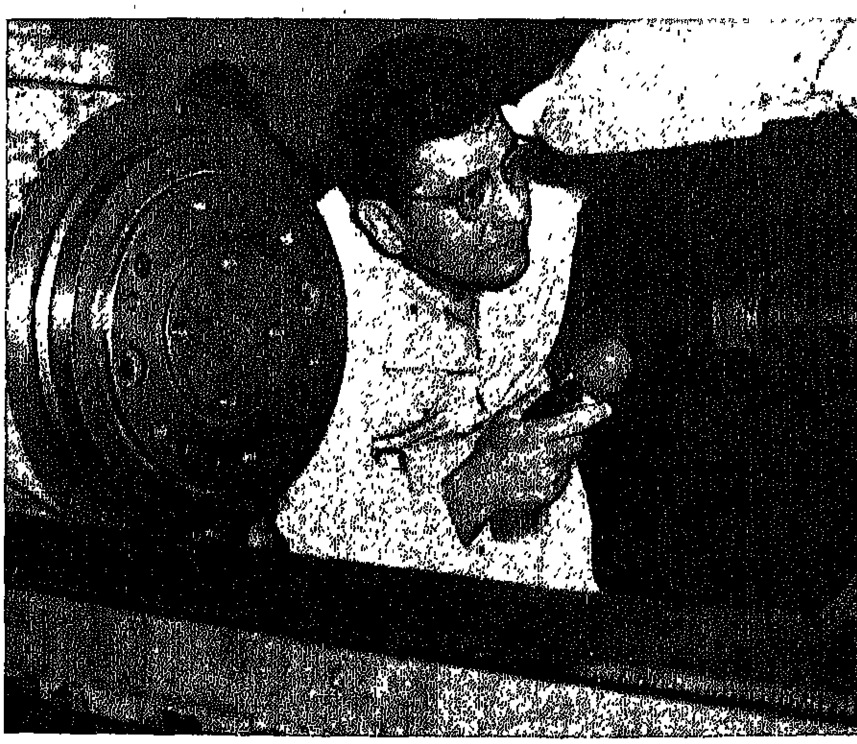
The DIPEC relationship with the Military Departments and their contractors is unique. A contractor is authorized to use government-owned IPE, when vital defense production cannot otherwise be obtained, under general criteria specified in the Armed Services Procurement Regulation and other policy directives. This authorization is included in facilities contracts or facility clauses to supply contracts. When a contractor is so authorized, he requisitions the authorized item from DIPEC through the administering contracting officer or his designee. DIPEC cannot accept requisitions directly from the contractor because DIPEC does not get copies of the authorizing contracts and, therefore, certification of validity by the local government representative is essential.

When the requisition is received, it is matched against the idle stocks in the general reserve to determine if a suitable item is available. This matching is done by equipment specialists who have years of actual experience in the various commodity areas in which they work. In the majority of instances the specific item requested is not available and it becomes necessary to screen for suitable substitutes. In fact, a very large percentage of the items supplied are substitutes. If a suitable item is available, which in our opinion will fill the requirement, it is offered to the requisitioner for his review and acceptance. Upon acceptance, the necessary movement instructions are initiated. If maintenance is required on the item, it is completed prior to shipment unless waived by the requisitioner.

If a suitable item is not available, a certificate of non-availability is issued in which case the contractor and the authorizing activity take further action to procure the item if the requirement is on a funded basis.

It is extremely difficult for the Military Services to project future requirements for IPE for several reasons. First, it is difficult to determine which end items of hardware will be required in any given situation. Second, and more important, until a contract is actually executed, it is im-

INSPECTION, PRESERVATION, repair and rebuild of industrial plant equipment is a major responsibility for DIPEC. Such work is performed at four facilities under the technical or operational control of DIPEC.



possible to forecast the specific items, if any, the successful bidder may be authorized. Lacking such projections from the Military Services, DIPEC uses historical demand as an indication of future need. Requirements of past years are used to arrive at demand rates which are, in turn, used to forecast future trends. The Military Services are now in process of developing mobilization requirements, so that DIPEC can establish mobilization reserve retention levels against which idle equipment will be held in anticipation of such demand.

It must be emphasized that DIPEC does not procure equipment for placement in the idle reserve. Only idle equipment, which is no longer required at its current location for the purpose authorized, can be placed in the idle reserve, and that is done only after three other conditions have been met. First, there must be no other immediate requirement; second, the item must be technically worthy of retention; and, third, the on-hand stock must be less than the projected retention level.

The review conducted prior to a decision to place an item in the idle reserve is extensive, particularly relative to its technical worth. The average item of IPE costs about $10,000 and weighs close to 6 tons. The costs inherent in preserving, shipping and storing this equipment are considerable. Therefore, we want to avoid any poor decisions that might result in disposal, after the costs to move the item to storage have already been experienced and when the item had no utilization potential in the first place. To this end, DIPEC has developed and uses an idle equipment appraisal technique which permits a uniform assessment of an item's technical value versus the costs to retain and reuse. This system largely eliminates personal judgment and permits effective documentation of the decisions reached.

Another important responsibility charged to DIPEC is the NIER program, the National Industrial Equipment Reserve. Some of this equipment, held in reserve to meet any national emergency, is also used in Federal programs designed to train persons for developing technical skills, especially among the hard-core unemployed. To date, DIPEC has furnished approximately 5,737 tools from the NIER to qualified technical schools and other programs in 40 states.

Assigned to DIPEC, in July 1965, was the DSA Industrial Equipment Reserve program. Special tooling from this program is furnished the DSA supply centers and their contractors for use in production of defense support materials, such as steel helmets, field kitchen equipment, concertina wire, and allied items. Maintaining files of engineering drawings, revising and developing new drawings to keep current with end-item changes is an important facet of this overall DSA Industrial Equipment Reserve responsibility.

Keeping Abreast of Changing Technology

In an era of ever-changing technology, DIPEC is geared to developing programs to keep abreast of such progress as we are presently witnessing in the field of numerically controlled machine tools. We are constantly updating our technicians in this and other fast-growing technologies. We do this in several ways. We send them to DOD schools or outside training classes. We visit trade shows and expositions. We participate in many industry and government technical seminars and association meetings. Also, we appreciate support given to us by industry in providing films, speakers and other training material.

The DIPEC organization is relatively straightforward and closely adheres to the DSA uniform structure. Overhead and staff functions are concentrated into the normal support elements. Direct operations are performed either by the Directorate of Supply Operations or the Directorate of Technical Operations. The Directorate of Supply Operations manages items, and the Directorate of Technical Operations develops the technical standards, specifications and catalogs under which items are managed.

DIPEC currently has a work force of approximately 475 people at its Memphis, Tenn., headquarters. Additional personnel are assigned to the storage/maintenance operations at the four sites. Originally, the nucleus of the center work force was drawn from the Military Department activities whose functions DIPEC assumed. To this nucleus has been added the most experienced equipment specialists and management personnel available.

Until now DIPEC has directly serviced only defense contractors and some large military production and maintenance facilities, such as arsenals and shipyards. However, many items of IPE used by these activities are identical or very similar to items used on DOD posts, camps, stations, bases and ships around the world. In August 1969, DIPEC began to provide the same level of IPE services for these activities as it has been giving to large military facilities and contractors. With this mission expansion, DIPEC will provide a single focal point for DOD-wide comparison of assets and requirements. Hopefully, this will maximize response to DOD equipment needs world-wide, while at the same time further reduce the need for new procurement.

Army To Get Electronic Teletypewriters

An electronic teletypewriter for use in forward combat areas has been developed for the Army under requirements set by the Combat Developments Command (CDC), Fort Belvoir, Va.

The equipment is designed in modular form to gain flexibility in operation, and utilizes electronic components to reduce weight. It is capable of operating on several coding systems, including the American Standard Code for Information Interchange, which is acceptable for use by information processing equipment, and the BAUDOT system, the Army-wide teletypewriter encoding system.

The new equipment is intended to provide teletypewriter capability over existing communications facilities, including tactical radio, field wire and radio relay, with a one-mile remote capability. Each unit can operate independently, with its own power supply and circuit adapter modules, giving each command flexibility to fit equipment to needs.

The equipment is intended for use down to the combat battalion level. CDC anticipates the unit to eventually replace six different sets now in the Army inventory.

Laboratory Planning— A New Order of Importance

Donald M. Ross

As viewed by the Air Force Rocket Propulsion Laboratory (AFRPL) located at Edwards AFB, Calif., laboratory planning has assumed a new order of importance. Prompted by budget reductions, advancing capabilities of competitive nations, and rising research and development costs, AFRPL has had to substantially revise its method of planning. Increased attention and consideration is given the activities and technological progress of other major nations, especially those of the Soviet Union and Communist China. Never before has the technological race been so close, and the need so great, for carefully setting the goals and approach for future Air Force technology programs.

The action of Headquarters, Air Force Systems Command, in adding a function of foreign technology assessment, and associated manpower, to AFRPL has proven very valuable to the revised planning procedures. With two years of experience in the new function, the laboratory is more fully equipped, not only to set program goals but to benefit from knowledge of approaches being followed by foreign countries. From expanded knowledge and appreciation of the competition, the laboratory gains motivation for increasing its management effectiveness throughout its entire operations. This includes a determination to team with other laboratories and with Air Force weapon system development organizations—in this case, the Aeronautical Systems Division (ASD) and the Space and Missile Systems Organization (SAMSO) of the Air Force Systems Command.

One factor which has a constant sobering effect upon the laboratory is the tremendous growth that is occurring in the size of the Soviet scientific and engineering professional work force. Just 15 years ago the United States enjoyed a professional S&E (scientists and engineers) work force which was at least three times that of the USSR. Now the two nations are essentially equal in numbers of scientists and engineers. The Soviet's rate of expansion currently is three times that of the United States. During the past five years, S&E graduates in the United States have ranged between 7 to 9 percent of the total degrees granted annually. Correspondingly, the percentage is 40 to 42 percent in the USSR based on 16th and higher grade graduates. In June 1969, the United States awarded approximately 75,000 S&E degrees, as contrasted to approximately 230,000 for the Soviets. Forecasts show this situation will continue unchanged for the next 5 to 10 years.

Impressed with the realization that "technology program results must translate to weapon systems of the future," AFRPL doubled the man years normally spent with ASD and SAMSO in deriving and agreeing upon "technology needs." This, during the past year, has been at the expense of working closely with industry inputs as has been the laboratory's annual practice during the month of November. With procedural improvements effected, the laboratory will re-establish its planning ties with industry this fall. Summarized, the calendar of planning activities being followed by AFRPL is:

- **September:** Update technology status and forecast to systems organizations.
- **October:** Review threat and advanced systems objectives; update technology needs.
- **November:** Meet with industry.
- **December:** Complete program plan.
- **January and February:** Coordinate program plan with systems organizations and higher headquarters.
- **March:** Finalize program documentation.
- **April:** Update technical objective documents and distribute to industry and government organizations.
- **May:** Initiate contract program work statements.

Donald M. Ross is currently serving as Acting Director of the Air Force Rocket Propulsion Laboratory. Mr. Ross has been engaged in Air Force propulsion research and development since early 1939. In 1959, he was appointed Chief Scientist at AFRPL, and later became the laboratory's Deputy Director. Mr. Ross holds a B.S. degree in mechanical engineering from the University of Washington.

• **June:** Finalize in-house program documentation and work schedule.

• **July:** Update technological threat.

• **August:** "Catch our breath."

Overall, the strengthened approach to laboratory planning is expected to benefit both Air Force and industry as definition and description of goals, priorities and approaches become clarified in the laboratory's plan.

Categorizing Technology Needs

The laboratory divides its technology needs (TNs) into two categories: essential or desirable. For example, a TN spelling out the properties and characteristics of bipropellant liquid rocket components, needed for development of a low-cost space launch vehicle to specified cost objectives, would be rated "essential," inasmuch as demonstrated technology of the type needed does not exist. Likewise, a rating of "desirable" would be applied to a TN which specifies a new storable liquid propellant combination with a density-impulse higher than proven state of the art. In the latter case, achievement of weapon system objectives can be met, using existing third-stage technology and letting the stage "grow" to the size required. Under the worst condition, the second or first stage would also need to be augmented using available technology.

The ratings of essential and desirable influence the priority the effort-task receives from the laboratory's budget. Other significant influences on the priority assigned to a specific technology effort-task include: the importance of the postulated weapon system to the nation's defense, and the time period of need adjusted for the degree of risk associated with achieving the necessary technology.

A most difficult aspect of planning technology relates to defining the "N + 1" generation weapon system objectives where "N" is the next ICBM, air launched missile, or other weapon system to be developed. Properly, TNs aimed at N + 1 generation weapon system objectives should evolve from analyses of conceptual systems needed to meet the threat 7 to 12 years hence.

As an indicator of essentiality, ongoing and newly proposed rocket propulsion technology efforts are categorized as "E" (essential), "D" (desirable), and "F" (failed) describing their merit for fulfilling the objectives of the TNs.

Programming of Resources

While effective management of the laboratory resources necessitates orienting the majority of the resources to postulated weapon systems, not all the laboratory's program efforts fit the narrowness of a single weapon system or a single class of weapon systems. Some of the work, *e.g.*, "Mechanical Behavior of Solid Propellants," is applicable to all solid propellant applications. Other work, such as "Synthesis of New Propellant Compounds," is so fundamental that only an estimate can be made as to whether a resulting compound might be solid or liquid. What percent of the laboratory's annual budget should be "oriented" versus "general?" The fraction of the laboratory's budget contained in "general" is influenced by several dominating factors including:

• Availability of funds for basic and applied research.

• Adequacy of the present inventory of weapon systems.

• Innovation of radically new weapons or missions.

• Detail to which work tasks are reduced and approached with manpower and funds within the laboratory.

Often the decision to include or omit a proposed technology effort can be reached through application of a very simple management test, as follows:

• The proposed program, with its postulated merits and results, is understood and agreed upon by proposer and management.

• Now the program has been completed and the results achieved to the degree and extent proposed.

• What will the results achieve that are beneficial to the N, N + 1, or subsequent weapon systems?

Seemingly attractive programs often fail this simple test in that the proposed results provide very small, if not highly doubtful, evolutionary improvement to future systems. With major weapon systems, each costing many billions of dollars and each being developed many years apart, competition is not matched or surpassed through sponsorship of low-merit technology programs. Invariably the present, well proven state of the art continues in the next system rather than facing the cost and risk of proving and qualifying a small incremental improvement.

Application of fund allotments to the oriented portion of the program plan occurs rather easily, giving recognition to the priorities of the TNs (and their related weapon system objectives), and to the magnitude of expenditures needed to establish the needed technology on time. How far down the priority listing will the fund allotment stretch? The final results of the method clearly post the answer for recognition by all interested parties. In similar fashion, the picture is clear as to what needs are not funded. On the basis that the method is sufficiently sound for building a budgeted program, it works equally well in exercising budget cutbacks.

Several months ago, AFRPL approached the new procedures with trepidation, but with strong conviction that past procedures were not sufficient for the future. With a "first-round" of experience complete from its FY 1970/1971 program effort, the laboratory clearly sees strength growing from the method—team strength between laboratories, between laboratories and weapon system development organizations, and between the Air Force and the nation's industry.

CDC Establishes Post-1975 Methodology for Army

The Army Combat Developments Command (CDC), Fort Belvoir, Va., has announced a new methodology to guide developmental efforts for the post-1975 Army, and a new office to coordinate and manage this effort.

Called Army Combat Developments Program (ACDP) Methodology, it will take advantage of data resources and experiences derived during CDC's recent Army–75 study.

Among other aspects, it will detail requirements for cost-effectiveness analysis and methods to ensure extensive use of CDC's expanding data base. One feature will be the Doctrinal Position Paper, an annual report to the Department of the Army providing review and adjustment of priorities.

The new office, Assistant to the Chief of Staff for Program Operations, is under the command of Colonel Albert J. Brown.

DEPARTMENT OF DEFENSE
PRIME CONTRACT AWARDS BY STATE

Net Value of Military Procurement Actions by Department [a]

Fiscal Year 1969

(Amounts in Thousands)

STATE	Total		Army	Navy	Air Force	Defense Supply Agency
	Amount	Percent				
TOTAL, U.S. [b]	$39,310,186		$11,731,424	$11,509,966	$11,440,942	$4,627,854
NOT DISTRIBUTED BY STATE [c]	4,061,395		1,065,143	1,197,675	947,568	851,009
STATE TOTALS [d]	35,248,791	100 0%	10,666,281	10,312,291	10,493,374	3,776,845
Alabama	407,726	1.2	203,236	43,650	78,148	82,692
Alaska	90,793	0.3	37,273	9,179	38,284	6,057
Arizona	343,730	1.0	151,830	53,050	128,514	10,336
Arkansas	117,179	0.3	37,576	7,297	46,089	26,217
California	6,824,433	19.4	1,311,537	2,231,379	2,640,993	640,534
Colorado	243,478	0.7	49,101	16,668	158,385	19,324
Connecticut	1,715,135	4.9	594,590	688,264	388,829	43,452
Delaware	46,762	0.1	11,916	6,468	6,391	21,988
District of Columbia	321,014	0 9	96,198	173,226	41,308	10,287
Florida	964,320	2.7	280,267	120,857	508,360	55,836
Georgia	932,901	2.6	92,280	60,310	715,459	64,852
Hawaii	114,627	0.3	36,827	52,483	20,786	4,531
Idaho	16,054	0.1	1,727	1,189	3,596	9,542
Illinois	932,495	2 6	482,729	128,127	155,087	166,552
Indiana	1,058,570	3.0	642,889	119,670	239,658	56,358
Iowa	202,119	0.6	56,122	40,886	42,354	62,757
Kansas	349,667	1 0	173,027	9,338	139,874	27,428
Kentucky	59,478	0 2	24,571	4,233	6,811	23,863
Louisiana	389,857	1.1	171,484	83,589	6,015	128,819
Maine	53,408	0.2	15,624	21,657	4,401	11,726
Maryland	731,282	2.1	151,087	330,422	214,106	35,667
Massachusetts	1,549,834	4.4	485,363	523,047	458,586	82,838
Michigan	683,202	1.9	461,992	51,015	93,006	77,189
Minnesota	741,169	2 1	277,114	232,227	197,524	34,304
Mississippi	218,937	0 6	13,671	139,884	21,604	43,178
Missouri	1,095,418	3.1	333,735	549,687	174,358	37,638
Montana	22,017	0 1	4,911	2,396	8,613	6,097
Nebraska	101,724	0.3	42,695	753	14,358	43,978
Nevada	27,118	0.1	10,930	4,219	10,580	1,384
New Hampshire	102,437	0.3	3,222	66,358	17,946	14,911
New Jersey	1,270,430	3 6	456,534	393,420	209,429	211,047
New Mexico	96,105	0.3	55,628	4,005	31,022	5,450
New York	3,074,316	8.7	735,690	1,469,888	571,968	296,770
North Carolina	514,789	1 5	274,795	93,574	22,440	123,930
North Dakota	35,807	0.1	5,327	791	10,398	19,291
Ohio	1,583,016	4.4	843,147	304,950	780,417	104,502
Oklahoma	173,493	0.5	34,695	12,289	81,392	45,062
Oregon	85,921	0.2	10,275	18,108	9,893	47,645
Pennsylvania	1,700,420	4.8	553,349	594,406	342,055	210,610
Rhode Island	119,268	0.3	13,491	82,886	4,427	18,464
South Carolina	172,520	0.5	39,349	35,543	23,656	73,972
South Dakota	3,478	*	2,700	—5,572	3,669	2,681
Tennessee	485,629	1 4	275,937	59,283	77,181	73,228
Texas	3,525,155	10.0	939,779	875,930	1,231,540	477,906
Utah	157,174	0 4	24,224	13,730	89,591	29,629
Vermont	85,445	0.2	69,122	2,898	12,304	1,121
Virginia	711,164	2.0	249,942	388,389	32,533	45,300
Washington	574,771	1.6	84,373	145,926	335,460	59,012
West Virginia	66,863	0.2	38,045	7,963	1,619	19,236
Wisconsin	393,646	1 1	254,222	47,824	35,309	56,291
Wyoming	13,207	*	250	82	7,112	5,813

For footnotes, see page 33.
*Less than 0.05 percent.

DEPARTMENT OF DEFENSE
PRIME CONTRACT AWARDS BY STATE

Net Value of Military Procurement Actions by Fiscal Year [a]

Fiscal Years 1966, 1967 and 1968

(Amounts in Thousands)

STATE	Fiscal Year 1966		Fiscal Year 1967		Fiscal Year 1968	
	Amount	Percent	Amount	Percent	Amount	Percent
TOTAL, U.S. [b]	$35,713,061		$41,817,093		$41,241,125	
NOT DISTRIBUTED BY STATE [c]	3,999,758		4,435,384		3,992,991	
STATE TOTALS [d]	31,713,303	100.0%	37,381,709	100 0%	37,248,134	100 0%
Alabama	281,549	0 9	297,065	0.8	409,189	1.1
Alaska	71,666	0.2	85,648	0 2	106.513	0.3
Arizona	248,228	0.8	249,563	0.7	287,065	0.8
Arkansas	95,701	0 3	127,180	0.3	121,254	0 3
California	5,813,078	18.3	6,688,812	17.9	6,471,875	17 4
Colorado	255,893	0.8	210,409	0.6	262,763	0.7
Connecticut	2,051,560	6.5	1,935,895	5.2	2,355,135	6.3
Delaware	37,445	0.1	51,672	0.1	42,614	0 1
District of Columbia	328,111	1.0	357,666	1.0	349,771	0.9
Florida	766,955	2 4	799,005	2 1	975,824	2.6
Georgia	799,862	2.5	1,148,355	2.1	964,162	2.6
Hawaii	64,170	0.2	65,445	0 2	95,623	0.3
Idaho	20,004	*	14,772	*	17,051	*
Illinois	919,779	2 9	1,063,776	2 8	932,111	2.5
Indiana	1,068,259	3.4	898,247	2.4	1,107,453	3.0
Iowa	247,619	0 8	279,328	0 8	260,980	0.7
Kansas	312,629	1 0	398,918	1 1	292,293	0 8
Kentucky	70,057	0.2	124,294	0.3	60,366	0.2
Louisiana	302,906	1.0	656,031	1.8	460,463	1 2
Maine	51,340	0.2	56,558	0.2	75,209	0 2
Maryland	842,527	2.7	868,396	2.3	703,514	1.9
Massachusetts	1,335,952	4.2	1,422,272	3.8	1,618,741	4 3
Michigan	918,426	2.9	1,033,706	2.8	796,296	2.1
Minnesota	497,994	1.6	650,584	1.7	620,297	1 7
Mississippi	162,305	0.5	114,800	0 3	369,249	1.0
Missouri	1,112,665	3.5	2,277,597	6 1	1,356,871	3 6
Montana	13,779	*	78,462	0.2	20,453	0 1
Nebraska	80,478	0.3	103,522	0.3	120,401	0.3
Nevada	32,028	0.1	29,315	*	17,397	*
New Hampshire	109,591	0.3	162,551	0.4	155,995	0.4
New Jersey	1,090,122	3.4	1,234,768	3.3	1,108,440	3 0
New Mexico	86,230	0.3	80,472	0.2	87,214	0.2
New York	2,819,153	8.9	3,261,750	8.7	3,488,780	9.4
North Carolina	449,331	1.4	447,408	1.2	487,259	1.3
North Dakota	83,113	0.3	16,729	*	68,072	0 2
Ohio	1,588,955	5.0	1,602,593	4 3	1,640,525	4.4
Oklahoma	158,492	0 5	157,350	0.4	164,944	0.4
Oregon	89,983	0 3	99,319	0 3	119,719	0.3
Pennsylvania	1,665,087	5.3	1,649,091	4 4	1,727,314	4.6
Rhode Island	131,722	0.4	198,030	0 5	126,362	0.3
South Carolina	176,424	0.6	180,777	0.5	133,027	0.4
South Dakota	23,315	0 1	9,486	*	33,585	0.1
Tennessee	502,168	1.6	538,225	1.5	541,631	1.5
Texas	2,291,454	7.2	3,546,978	9.5	4,087,182	11.0
Utah	169,681	0.5	178,350	0.5	131,172	0.4
Vermont	81,066	0.3	100,157	0.3	104,957	0.3
Virginia	425,487	1.3	665,376	1.8	692,748	1.9
Washington	444,368	1.4	606,114	1.6	529,588	1.4
West Virginia	149,300	0.5	141,780	0.4	132,002	0 4
Wisconsin	364,684	1.1	383,602	1.0	406,409	1.1
Wyoming	11,112	*	32,868	0.1	14,851	*

For footnotes, se page 33.
*Less than 0.05 percent.

DEPARTMENT OF DEFENSE
PRIME CONTRACT AWARDS BY STATE

Net Value of Civil Functions Procurement Actions [a] [e]

Fiscal Years 1966, 1967, 1968 and 1969

(Amounts in Thousands)

STATE	Fiscal Year 1966 Jul 65–Jun 66	Fiscal Year 1967 Jul 66–Jun 67	Fiscal Year 1968 Jul 67–Jun 68	Fiscal Year 1969 Jul 68–Jun 69
TOTAL, U.S. [b]	$878,301	$819,218	$845,295	$684,776
NOT DISTRIBUTED BY STATE [c]	43,532	40,875	44,810	41,727
STATE TOTALS [d]	834,769	778,343	800,485	643,049
Alabama	16,299	18,441	21,921	20,296
Alaska	15,808	2,818	7,250	1,364
Arizona	2,816	2,742	6,881	275
Arkansas	89,427	81,658	67,525	50,267
California	57,844	52,991	56,465	53,850
Colorado	922	1,539	3,471	2,616
Connecticut	5,197	7,212	5,761	6,010
Delaware	8,973	12,658	6,024	3,929
District of Columbia	866	1,071	299	1,799
Florida	26,279	35,334	30,439	21,059
Georgia	7,345	9,390	15,333	6,492
Hawaii	1,439	244	711	4,338
Idaho	5,822	19,556	26,290	33,359
Illinois	22,192	18,046	25,919	29,285
Indiana	25,080	18,052	21,627	11,127
Iowa	12,160	14,578	12,705	12,421
Kansas	12,884	11,611	7,158	9,256
Kentucky	20,219	21,701	19,438	11,394
Louisiana	54,921	40,600	41,074	25,769
Maine	1,628	1,326	1,087	749
Maryland	10,212	1,716	4,055	2,308
Massachusetts	5,065	2,703	4,879	2,058
Michigan	13,027	10,915	8,050	8,727
Minnesota	4,128	3,902	4,398	5,347
Mississippi	16,594	18,300	10,586	9,631
Missouri	29,799	30,941	26,417	25,186
Montana	8,774	21,840	52,656	45,139
Nebraska	8,613	6,112	6,860	3,378
Nevada	0	17	33	37
New Hampshire	1,693	107	156	238
New Jersey	3,303	2,163	4,388	3,773
New Mexico	3,748	5,955	9,157	5,755
New York	12,400	8,351	14,726	13,955
North Carolina	4,004	3,534	2,329	3,285
North Dakota	8,311	2,151	1,462	2,667
Ohio	15,884	12,442	18,639	22,795
Oklahoma	81,514	48,773	51,698	34,197
Oregon	86,906	44,354	29,995	15,392
Pennsylvania	37,776	37,760	30,445	30,072
Rhode Island	4,491	574	4,234	4,303
South Carolina	2,472	2,571	4,151	2,707
South Dakota	6,351	2,249	1,662	1,837
Tennessee	18,773	14,039	12,141	7,253
Texas	32,910	28,317	32,503	26,722
Utah	565	0	25	142
Vermont	58	90	101	385
Virginia	6,860	8,764	8,992	8,718
Washington	55,957	58,974	54,128	37,500
West Virginia	23,182	24,039	18,987	9,728
Wisconsin	4,094	5,122	4,775	6,203
Wyoming	290	0	34	21

For footnotes, see page 33.
*Less than 0.05 percent.

DOD Prime Contract Awards by State

Footnotes

[a]See Notes on Coverage below.

[b]Includes all contracts awarded for work performance in the United States. The United States includes the 50 states, the District of Columbia, U.S. possessions, the Canal Zone, the Commonwealth of Puerto Rico, and other areas subject to the complete sovereignty of the United States, but does not include occupied Japanese Islands and Trust Territories.

[c]Includes contracts of less than $10,000, all contracts awarded for work performance in the Commonwealth of Puerto Rico, U.S. possessions, and other areas subject to the complete sovereignty of the United States, contracts which are in a classified location, and any intragovernmental contracts entered into overseas.

[d]Net value of contracts of $10,000 or more for work in each state and the District of Columbia.

[e]Includes civil functions of the Army Corps of Engineers for flood control and rivers and harbor work. Civil functions data are shown separately, and are not included in military functions tabulations.

Notes on Coverage

It is emphasized that data on prime contracts by state do not provide any direct indication as to the state in which the actual production work is done. For the majority of contracts with manufacturers, the data reflect the location of the plant where the product will be finally processed and assembled. If processing or assembly is to be performed in more than one plant of a prime contractor, the location shown is the plant where the largest dollar amount of work will take place. Construction contracts are shown for the state where the construction is to be performed. For purchases from wholesale or other distribution firms, the location is the address of the contractor's place of business. For service contracts, the location is generally the place where the service is performed, but for transportation and communications services the home office address is frequently used.

More important is the fact that the reports refer to prime contracts only, and cannot in any way reflect the distribution of the very substantial amount of material and component fabrication and other subcontract work that may be done outside the state where final assembly or delivery takes place.

The report includes definitive contracts and funded portions of letter contracts and letters of intent, job orders, task orders, and purchase orders on industrial firms, and also includes interdepartmental purchases, made from and through other government agencies, such as those made through the General Services Administration. The state data include upward or downward revisions and adjustments of $10,000 or more, such as cancellations, price changes supplemental agreements, amendments, etc.

The estimated amounts of indefinite delivery open-end, or call type contracts for petroleum are included in the report. Except for petroleum contracts, the report does not include indefinite delivery, open-end, or call type contracts as such, but does include specific purchases or delivery orders of $10,000 or more which are placed against these contracts. Also excluded from the report are project orders, *i.e.*, production orders issued to government-owned-and-operated facilities such as Navy shipyards. However, the report includes the contracts placed with industry by the government-operated facility to complete the production order.

Two STRATCOM Units Merge

The Army Strategic Communications Command (USASTRATCOM), Fort Huachuca, Ariz., has announced the merger of two subordinate commands. The action, aimed at greater economy and increased operational effectiveness, involved the Joint Support Command, Fort Ritchie, Md., and the Army Strategic Communications Command—CONUS, Washington, D.C., which merged to form the National Communications Command (Provisional).

Colonel Thomas W. Riley, former commander of the Joint Support Command, heads the new organization, headquartered in the Hoffman Building, Alexandria, Va.

Bulletin Verifies Mailing List

Annual verification of the mailing list of the *Defense Industry Bulletin* is required by the Joint Congressional Committee on Printing and the Bureau of the Budget.

Coincident with the mailing of the October issue, each subscriber on the list in October was sent a mailing list verification card. Every subscriber, who wishes to receive the *Bulletin* during 1970 must return his card before January 1, 1970. The cards are self-addressed and postage is prepaid. Provision is also made to use the cards to correct addresses.

New subscribers, receiving the *Bulletin* for the first time in November, were not included in the mailing of verification cards, and are not required to respond to the survey. Their subscriptions will continue through 1970.

Future correspondence concerning editorial or circulation matters should be sent to the Bulletin's new address: Editor, Defense Industry Bulletin, Defense Supply Agency (DSAH-B), Cameron Station, Alexandria, Va. 22314.

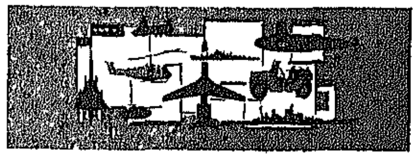
MERDC Testing New Structural System

A new structural system, the Universal Folded Plate (UFP), for use in prefabricated structures is undergoing tests by the Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va. Limited testing has indicated that the system will produce a greater variety of structures than most other modular construction systems.

The basic building block is a folded diamond plate, which can be mass produced in either metal or reinforced plastic. The plates are then connected in either identical or reversed fold positions, creating the variety of structures available.

The metal and plastic plates can also be used in combination to provide structures of minimum weight and maximum light transmission. Water-sealing at the joints is provided by extruded compressible elastromeric gaskets, bonded to the edges of the plates.

The initial testing program includes panels made of 10 and 18 gauge steel and reinforced plastic.



DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of September 1969.

DEFENSE SUPPLY AGENCY

2—The Defense Fuel Supply Center, Alexandria, Va , awarded the following contracts for gasoline and fuel oil:

Gulf Oil Corp., Houston, Tex. $8,921,000. DSA 600-70-D-0434.

Metropolitan Petroleum Co., New York, N.Y. $2,864,522. DSA 600-70-D-0448.

Atlantic Richfield Co., Philadelphia, Pa. $1,844,500. DSA 600-70-D-0408.

Hess Oil and Chemical Corp., Woodbridge N.J. $1,701,580. DSA 600-70-D-0439.

—Plastoid Corp., Hamburg, N.J. $1,697,180. 33,860 one-mile reels of telephone cable (type WD1/TT). Defense Industrial Supply Center, Philadelphia, Pa. DSA 500-70-C-2603.

—OJUS Industries, Inc., Miami, Fla. $1,110,720. 138,840 rolls of barbed concertina tape for the Army. Defense Construction Supply Center, Columbus, Ohio. DSA 700-70-C-2552.

5—Pettibone Mulliken Corp., Washington, D.C. $4,144,408. 239 rough terrain fork lift trucks for the Air Force and Marines. Chicago, Ill. Defense General Supply Center, Richmond, Va DSA 400-70-C-1078.

—International Harvester Co., Melrose Park, Ill. $1,382,312. 16 IHC Model H50-C loaders and 48 IHC Model 175B-2 loaders. Chicago and Libertyville, Ill. Defense Construction Supply Center, Columbus, Ohio. DSA 700-70-C-0800.

12—Island Creek Coal Sales Co., Cleveland, Ohio. $1,684,260. 279,000 tons of bituminous coal. Coal Mountain, Mabley, Kelly, and Stowe, W.Va., and Brier Creek and Fies, Ky. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-D-0123.

16—J. B. Manufacturing Co., San Antonio, Tex. $1,837,997. 550,250 men's short sleeve khaki cotton shirts. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0503.

18—Delta Petroleum Co., Inc., New Orleans, La. $1,150,965. 2,876,605 gallons (55-gallon drums) engine lubricating oil. Defense Fuel Supply Center, Alexandria, Va. DSA 640-70-D-0586.

22—Fire Trucks, Inc., Mount Clemens, Mich. $1,420,421. Fire fighting trucks. Defense Construction Supply Center, Columbus, Ohio. DSA 700-70-C-8250.

—Chesebrough-Ponds, Inc., New York, N.Y. $1,019,549. 1,558,944 first aid dressings Sherburne, N.Y. Defense Personnel Support Center, Philadelphia, Pa. DSA 120-70-C-0617.

24—Glenn's All American Sportswear, Inc., Amory, Miss. $1,937,162. 590,818 pairs men's cotton uniform trousers. Sulligent, Ala., and Hatley, Miss. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0561.

25—J. P. Stevens and Co., Inc., New York, N.Y. $2,287,030. 1,199,000 yards of tropical wool and polyester cloth (Air Force). Greer and Wallace, S.C Defense Personnel Support Center, Philalphia, Pa. DSA 100-70-C-0558.

26—Shell Oil Co., New York, N.Y. $3,741,324. Automotive gasoline for installations in the Southwest Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-D-0339.

—Oregon Freeze Dry Foods, Inc., Albany, Ore. $1,895,152. 134,976 cans of cooked dehydrated shrimp Defense Personnel Support Center, Philadelphia, Pa. DSA 130-70-C-E007.

—Hercules Oil Co of San Diego, Inc., Long Beach, Calif. $1,425,037. Fuel oil and gasoline for installations in the Southwest. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-D-0327.

—United Fruit and Food Corp., Westwood, Mass. $1,279,807. 91,584 cans of cooked dehydrated shrimp. Edinburg, Tex. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-70-C-E008.

30—Mobil Oil Corp., New York, N.Y. $37,558,044. 317,256,300 gallons of JP-5 jet fuel. Ferndale, Wash., and Torrance and Los Angeles, Calif. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-C-0569.

—Alpha Industries, Inc , Knoxville, Tenn. $1,152,402. 202,661 men's cotton-nylon coats with hoods (WRS OG-107). Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0606.

—Rolane Sportswear, Inc., Ridgly, Tenn. $1,048,788. 174,174 men's cotton-nylon coats with hoods (WRS OG-107). Defense Personnel Suppot Center, Philadelphia, Pa. DSA 100-70-C-0607.

DEPARTMENT OF THE ARMY

2—Philco-Ford Corp., Newport Beach, Calif. $84,139,659. Shillelagh missiles. Lawndale Army Ammunition Plant, Hawthorne, Calif., and Iowa Army Ammunition Plant, Burlington, Iowa. Army Missile Command, Huntsville, Ala. DA-AH01-69-C-0059.

—Hercules Engines, Inc., Canton, Ohio. $1,885,666 (contract modification). Model DS465-1A multi-fuel engines for 5-ton trucks for the Marine Corps. Army Tank Automotive Command, Warren, Mich. DA AE07-67-C-4394.

—Van Buskirk Construction Co., and Buskirk-Cook Construction Co., Sioux City, Iowa. $1,265,507. Construction of recreation facilities, 25 miles of road, and parking areas, Rathbun Reservior Project, Iowa. Army Engineer District, Kansas City, Mo DA-CW41-70-C-0011.

3—AAI Corp., Cockeysville, Md. $2,953,500. 40mm grenade launchers. Army Procurement Agency, New York, N.Y. DA-AG25-70-C-0127.

—Bucyrus-Erie Co., Evansville, Ind., $1,114,154 (contract modification). 12½-ton crawler mounted shovel cranes. Erie, Pa. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-69-C-A362.

4—Pace Corp., Memphis, Tenn. $1,510,810. Surface flares. Camden and Russell, Ark., and Memphis. Picatinny Arsenal, Dover, N.J. DA-AA21-70-C-0137.

5—Honeywell, Inc., North Hopkins, Minn. $2,417,907. Grenade fuzes. DA-AA09 70-C-0027. $1,413,258. Grenade fuzes. St. Louis Park, Minn. DA-AA09-70-C-0026. $5,000,000. Grenade fuzes. Twin Cities Army Ammunition Plant, Minn. DA-AA09-70-C-0026. Army Ammunition Procurement and Supply Agency, Joliet, Ill

—Scovill Manufacturing Co., Waterbury, Conn. $1,499,148. Grenade fuzes. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0023.

—Bell and Howell Co., Chicago, Ill. $1,229,850. Grenade fuzes. Evanson, Ill. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0013

—Hercules, Inc., Wilmington, Del. $1,048,023 (contract modification). Production of propellants and explosives, and support services, Radford Army Ammunition Plant, Radford, Va. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-0037(A).

—Martin K. Eby Construction Co., Inc., Wichita, Kan. $15,228,975. Construction work at the Cordell Hull Lock and Dam Project, near Carthage, Tenn. Army Engineer District, Nashville, Tenn. DA-CW62-70-C-0013.

—Honeywell, Inc., Tampa, Fla. $4,500,000 (contract modification). Classified electronic equipment. Army Electronics Command, Fort Monmouth, N.J.

—Continental Motors Corp., Mobile, Ala. $1,221,893 (contract modification). Remanufacture of multi-fuel engine assemblies, models LDS 465-1A and -1. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-5296.

—Campbell Chain Co., York, Pa. $1,512,631. Various size tire and cross chains. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-0969.

8—Kennedy Van Saun Corp., Danville, Pa. $3,343,338. Metal parts for 105mm projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0037.

—Continental Motors Corp., Muskegon, Mich. $2,200,574. Kit cylinder sleeves and piston asemblies. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-0955.

—Applied Devices Corp., College Point, N.Y. $3,262,500. Radar station Hawk simulators. Army Missile Command, Redstone Arsenal, Huntsville, Ala. DA-AH01-69-C-1893.

—Marquardt Corp., Van Nuys, Calif. $1,110,959. 66mm rocket warheads and precison liners. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0374.

9—The Boeing Co., Philadelphia, Pa. $2,133,054. Rear rotary blades for the CH-47. DA-AJ01-68-A-0005. $1,734,816. Forward rotary wing blades for the CH-47. DA-AJ01-68-A-0005. Army Aviation Systems Command, St. Louis, Mo.

10—Chadwick and Buchanan, Long Beach, Calif. $1,267,500. Restoration of the Santa Ana River channel from Santiago Creek to the Pacific Ocean. Army Engineer District, Los Angeles, Calif. DA-CW09-70-C-0015.

11—Continental Motors Corp., Muskegon, Mich. $1,270,887. Engineering support of multi-fuel engines for 2½- and 5-ton trucks. Muskegon and Detroit, Mich. Army Tank Automotive Command, Warren, Mich. DA-AE07-67-C-5606

—E. D. Etnyre Co., Oregon, Ill. $1,126,477. 100 bituminous (BIT) distributors, 800-gallon tank type. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-70-C-1746.

15—Bulova Watch Co., Providence, R.I. $2,099,900. M525 fuze head assemblies. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0045.

—REDM Corp., Wayne, N.J. $1,392,750. M525 fuze head assemblies. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0044.

—General Motors Corps., Indianapolis, Ind. $2,296,000. 81mm projectiles. Cleveland, Ohio. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0058.

—R. G. LeTourneau, Inc., Longview, Tex. $10,374,000. Metal parts for 750-pound bombs. Lone Star and Longview, Tex. Army Ammunition Procurement and Sup-

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company — Value — Material or Work to be Performed—Location of Work Performed (if other than company plant)—Contracting Agency—Contract Number.

ply Agency, Joliet, Ill. DA-AA09-70-C-0035.

—American Machine and Foundry Co., New York, N.Y. $6,914,200. Metal parts for 750-pound bombs. Garden City, N.Y., and overseas. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0036.

—Chamberlain Corp., Elmhurst, Ill. $5,320,000. 81mm projectiles. Burlington, N.J. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0057.

—Hayes Albion Corp., Albion, Mich. $1,932,000. 81mm projectiles. Hillsdale, Mich. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0055.

—Atlantic Research Corp., Alexandria, Va. $2,214,324. Redeye missile rocket motors. Army Missile Command, Redstone Arsenal, Huntsville, Ala. DA-AH01-70-C-0276.

—Cadillac Gage Co., Warren, Mich. $1,352,676 (contract modification). Commando V-100 armored cars, XM706. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-0744

—General Dynamics Corp., Rochester, N.Y. $1,750,398. Radio teletypewriter sets, AN/GRC-142. Orlando, Fla. Procurement Division, Army Electronics Command, Philadelphia, Pa. DA-AB05-68-C-0035.

16—Wilkinson Manufacturing Co., Fort Calhoun, Nebr. $1,165,500. Metal parts for 60mm M2 fin asemblies. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0049.

—Raytheon Co., Andover, Mass. $3,135,156 (contract modification). Design and fabrication of factory test equipment for the improved Hawk system. Army Missile Command, Huntsville, Ala. DA-AH01-67-C-A028.

—Ford Motor Co., Highland Park, Mich. $17,313,669. Increment for ¼-ton trucks (M-151A2). Michigan Army Missile Plant, Warren, Mich. DA-AE06-68-C-001.

—Philco-Ford Corp., Newport Beach, Calif. $4,200,000. Long lead components for Chaparral ground support equipment, Anaheim, Calif. Army Missile Command, Redstone Arsenal, Huntsville, Ala. DA-AH01-70-C-0230.

17—General Motors Corp., Indianapolis, Ind. $1,771,370 (contract modification). Transmission assemblies for the M551 Sheridan tank. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-3436.

18—Bell Aerospace Corp., Fort Worth, Tex. $11,550,000 (contract modification). Air Force UH-1H helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-C-0028.

19—Bell Helicopter Co., Fort Worth, Tex. $6,625,000. CUH-1N helicopters for Canada. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-70-C-0234.

22—General Motors Corp., Indianapolis, Ind. $5,087,337. M551 armored reconnaissance airborne assault vehicles. Cleveland, Ohio. Army Weapons Command, Rock Island Arsenal, Ill. DA-11-199-AMC-00610(W).

—Western Electric Co., New York, N.Y. $55,000,000. Contract extension for Safeguard research and development through Nov. 3, 1969

23—Walter Kiddie, Inc., Belleville, N.J. $1,017,207. Air compressors for the Chaparral missile system. Army Missile Command, Redstone Arsenal, Huntsville, Ala. DA-AH01-70-C-0270.

24—CONDEC Corp., Old Greenwich, Conn. $42,649,468. 1¼-ton cargo trucks. Charlotte, N.C., and Schenectady, N.Y. Army Tank Automotive Command, Warren, Mich. DA-AE07-68-C-2606.

—Atlas Chemical Industries, Inc., Wilmington, Del. $16,226,966 (contract modification). *Production of TNT. Chattanooga, Tenn.* Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00531(A).

—Hercules, Inc., Wilmington, Del. $13,894,806 (contract modification). Production of propellants and explosives. Radford, Va. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00037(A).

—General Motors Corp., Detroit, Mich. $9,917,631. Diesel engines for M561 trucks. Army Tank Automotive Command, Warren, Mich. DA-AE07-68-C-2597.

—Lasko Metal Products, Inc., West Chester, Pa. $3,637,540. SUU-14A/A bomb dispensers. West Chester and Humboldt, Tenn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0070.

25—Bendix Corp., Teterboro, N.J. $2,032,500. Stabilized platform and amplifier control power supply sets for the Pershing missile system. Army Procurement Agency, New York, N.Y. DA-AH01-69-A-0042.

—Remington Arms Co., Bridgeport, Conn. $1,841,318 (contract modification). Load, assemble and pack small arms ammunition. Independence, Mo. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-49-010-AMC-00003(A)

—General Motors Corp., Indianapolis, Ind. $1,457,280. Transmission assemblies for the M113A1 family of vehicles. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-0091.

26—Ford Motor Co., Highland Park, Mich. $13,614,150. ¼-ton utility trucks. Project Manager, General Purpose Vehicles, Michigan Army Missile Plant, Warren, Mich. DA-AE06-C-0001

—Stromberg-Carlson Corp., Rochester, N.Y. $2,660,000. Integration/maintenance management and technical operation services for the automatic telephone system in Southeast Asia. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-67-C-0580.

—White Motor Corp., Lansing, Mich. $2,341,419 (contract modification). 2½-ton trucks. Project Manager, General Purpose Vehicles, Michigan Army Missile Plant, Warren, Mich. DA-AE06-69-C-0003.

—A. D. Roe Co., Inc., Louisville, Ky. $1,172,800. Construction of a non-commissioned officers open mess, Fort Knox, Ky. Army Engineer District, Louisville, Ky. DA-CA27-70-C-0014.

—The Institute for Defense Analysis, Arlington, Va. $1,076,738 (contract modification). Basic and applied research for DDR and E, and ARPA. Defense Supply Service, Washington, D.C. DA-HC15-67-C-0011.

—The Army Ammunition Procurement and Supply Agency, Joliet, Ill., awarded the following contracts:

Olin Mathieson Chemical Corp., East Alton, Ill. $37,168,808 (contract modification). Rocket propellant and ammunition components. Charleston, Ind. DA-AA09-69-C 0148. $11,621,988. 81mm projectile loading assemblies. Marion, Ill. DA-AA09-70-C-0108.

Eastman Kodak Co., Kingsport, Tenn. $16,738,338 (contract modification). Explosives. DA-11-173-AMC-00035(A).

Kisco Co., Inc., St. Louis, Mo. $16,258,000. Metal parts for 105mm cartridge cases. DA-AA09-70-C-0083.

Norris Industries, Inc., Los Angeles, Calif. $7,699,020. Metal parts for 105mm cartridge cases. Pico Rivers, Calif. DA-AA09-70-C-0082.

Bell and Howell Corp., Chicago, Ill. $1,235,812. Metal parts for M84A1 time fuzes. Evanston, Ill. DA-AA09-70-C-0067.

Kilby Steel Co., Anniston, Ala. $1,025,640. 4.2-inch projectiles. DA-AA09-70-C 0066.

29—The Army Ammunition Procurement and Supply Agency, Joliet, Ill., issued the following contracts:

Uniroyal, Inc., New York, N.Y. $3,415,366 (contract modification). Explosives, and loading, assembling and packing of cluster bombs. Army Ammunition Plant, *Joliet, Ill. DA-11-173-AMC-00062(A).*

Farmers Chemical Association, Inc., Tyner, Tenn. $2,689,050 (contract modification). Mixed acids. Chattanooga, Tenn. DA-11-173-AMC-00300(A).

Hercules, Inc., Wilmington, Del. $12,780,600 (contract modification). Propellants and explosives Radford, Va. DA-11-173-AMC-00037(A).

Rulon Co., Chicago, Ill. $1,866,694. Metal parts for delay plungers for M557 artillery fuzes. DA-AA09-70 C-0089.

Z D Products Div., Wells Marine, Inc., Costa Mesa, Calif. $2,140,820. Metal parts for M557 artillery fuze delay plungers. DA-AA09-70-C-0090.

—FMC Corp., San Jose, Calif. $31,936,540. M113 series vehicles. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-2600.

30—The following contracts were awarded by the Ammunition Procurement and Supply Agency, Joliet, Ill.

Day and Zimmermann, Inc., Philadelphia, Pa. $8,395,350 (contract modification). Load, assemble and pack 105mm cartridges without fuzes. Lone Star Army Ammunition Plant, Texarkana, Tex. DA-11-173 AMC-00114(A).

Donovan Construction Co., New Brighton, Minn. $9,590,880. Metal parts for 155mm high explosive projectiles. DA-AA09-70-C-0085.

Remington Arms Co., Inc., Bridgeport, Conn. $18,447,900 (contract modification). Load, assemble and pack .50 caliber ball and tracer cartridges. Lake City Army Ammunition Plant, Independence, Mo. DA-49-010-AMC-00003(A).

Sperry Rand Corp., New York, N.Y. $1,938,500 (contract modification). Load, assemble and pack demolition charges and anti-personnel mines. Army Ammunition Plant, Shreveport, La. DA-11-173-AMC-00080(A).

Federal Cartridge Corp., Minneapolis, Minn. $5,969,300 (contract modification). Production of small arms ammunition. Twin Cities Army Ammunition Plant, New Brighton, Minn. DA-36-038-AMC-1099(A).

Firestone Tire and Rubber Co., Ravenna, Ohio. $6,239,500 (contract modification). Load, assemble and pack 40mm cartridges, and 8-inch and 175mm projectiles. DA-AA-09-70-C-0002.

Mason and Hanger, Silas Mason Co., Inc., Lexington, Ky. $3,391,374 (contract modification). Loading, assembling and packing of detonators and grenade fuzes. Army Ammunition Plant, Burlington, *Iowa. DA-AA09-68-C-0468.*

Stewart-Warner Corp., Lebanon, Ind. $1,558,275. Metal parts for 60mm high explosive projectiles. DA-AA09-70-C-0078.

National Presto Industries, Inc., Eau Claire, Wis. $30,775,307 (contract modification). Metal parts for 105mm high explosive projectiles. DA-AA09-69-C-0028.

Amron-Orlando Corp., Orlando, Fla. $3,020,832. Metal parts for point detonating fuzes. DA-AA09-70-C-0103.

Honeywell, Inc., North Hopkins, Minn. $9,058,329. Metal parts for point detonating fuzes. New Brighton, Minn. DA-AA09-70-C-0104.

Eison Brothers, Inc., Lodi, N.J. $4,014,686. Metal parts for 40mm high explosive projectiles. DA-AA09-70-C-0077.

Heckethorn Manufacturing Co., Dyersburg, Tenn. $2,309,708. Metal parts for 40mm high explosive projectiles. DA-AA09-70-C-0076.

Levinson Steel Co., Pittsburgh, Pa. $2,600,550 (contract modification). Metal parts for 105mm high explosive projectiles. DA-AA09-69-C-0023.

Chamberlain Manufacturing Co., New Bedford, Mass. $9,689,281. Metal parts for 155mm high explosive projectiles. DA-AA09-70-C-0075.

Chamberlain Manufacturing Co., Elmhurst, Ill. $1,010,475. Metal parts for 105mm illuminating projectiles. Waterloo, Iowa. DA-AA09-70-C-0105.

Chamberlain Manufacturing Co., Waterloo, Iowa. $1,015,200. Metal parts for 2.75 inch rocket smoke warheads (M156). DA-AA09-70-C-0109.

—North American Rockwell Corp., Anaheim, Calif. $1,370,998 (contract modification). Work on the Army Materiel Command Technical Data Configuration Management Systems. Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C-0042.

—Collins Radio Co., Newport Beach, Calif. $1,500,000. Classified electronics. Army Electronics Command, Fort Monmouth, N.J.

—Chrysler Corp., Detroit, Mich. $24,000,000. M60A1 tank and tank chassis, M728 combat engineer vehicles and repair/production equipment. Warren, Mich. Army Weapons Command, Rock Island, Ill. DA-AF03-70-C-0014.

—Hughes Tool Co., Culver City, Calif. $1,207,460. OH-6A light observation helicopters. Culver City and San Diego, Calif. Army Aviation Systems Command, St. Louis, Mo DA-AJ01-69-C-0688.

—General Dynamics Corp., Pomona, Calif. $2,203,877. FY 1970 engineering services for the Redeye missile system. Army Missile Command, Huntsville, Ala. DA-AH01-70-C-0303.

—Glassman Construction Co., Inc., Washington, D.C. $3,463,000. Construction of shopping center, Forest Glen Annex, Walter Reed Army Medical Center, Md. Army Engineer District, Baltimore, Md. DA-CA31-70-C-0016.

—United Aircraft Corp., Stratford, Conn. $9,435,002. CH-54B helicopters with engine air particle separators. Army Aviation Sys-

tems Command, St. Louis, Mo. DA-AJ01-70-C-0306.

—Bell Aerospace Corp., Tucson, Ariz. $1,317,450 (contract modification). Technical services for installing and servicing the Environmental Data and Processing Facility. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-68-C-0029.

—Raytheon Co., Andover, Mass. $7,950,010 Engineering services for the improved Hawk missile system. Andover and Bedford, Mass., and White Sands Missile Range, N.M. Army Missile Command, Huntsville, Ala. DA-AH07-70-C-1095.

—Metatronics Manufacturing Corp., Hicksville, N.Y. $1,044,765. Shipping and storage containers for Shillelagh guided missiles Army Missile Command, Huntsville, Ala DA-AH01-70-C-0310.

—The Greater Anchorage Area Borough, Alaska. $1,020,927 Construction of a sewage treatment plant, Anchorage, and connecting line to Fort Richardson, Alaska. Army Engineer District, Alaska. DA-CA85-70-C-0016.

—Stanford Research Institute, Menlo Park, Calif. $1,000,00. Continued study on anti-missile missile system. Huntsville, Ala., and Menlo Park. Safeguard System Command, Huntsville, Ala. DA-HC60-69-C-0004.

—Western Electric Co., New York, N.Y. $8,909,488. Continuation of radar measurement program in support of Kwajalein National Missile Range. Bell Telephone Laboratories, Whippany, N.J., and RCA, Moorestown, N.J. DA-HC-60-69-C-0001. $17,800,000 (contract modification). Advanced development studies for ballistic missile defense. Bell Telephone Laboratories, Whippany, N.J., Cornell Aeronautical Labs, Buffalo, N.Y., TRW Systems Inc., Redondo Beach, Calif. and other subcontractors. DA-HC60-69-C-0008. Safeguard System Command, Huntsville, Ala.

DEPARTMENT OF THE NAVY

2—Westinghouse Electric Corp., Pittsburgh, Pa. $29,000,000. Nuclear reactor compartment components. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5101.

—Hughes Aircraft Co., Canoga Park, Calif. $4,100,000. Design, documentation, manufacture and test of Walleye II missiles. Canoga Park and Tucson, Ariz. Naval Purchasing Office, Los Angeles, Calif. N00123-69-C-1539

3—Honeywell Inc., St. Petersburg, Fla. $1,116,360. Repair of inertial components in support of the Polaris missile guidance system. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0088.

—Hughes Aircraft Co., Culver City, Calif. $2,200,000. Poseidon missile guidance system electronic assemblies. El Segundo, Calif. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0056.

4—Lockheed Aircraft Corp., Burbank, Calif. $10,000,000 (contract modification). Incremental funding for the S-3A weapon system. Naval Air Systems Command, Washington, D.C. N00019-69-C-0385.

—North American Rockwell Corp., Columbus, Ohio. $9,073,477. Incremental funding for Condor missile system engineering development. Naval Air Systems Command, Washington, D.C. NOw 66-0728.

—United Aircraft Corp., Windsor Locks, Conn. $3,081,800 (contract modification). Propeller systems for P-3C aircraft. Naval Air Systems Command, Washington, D.C. N00019-69-C-0607.

—Philco-Ford Corp., Fort Washington, Pa. $1,340,280. Modification kits for sonar equipment. Naval Ship Systems Command, Washington, D.C. N00024-68-C-1132.

IBM Corp., Oswego, N.Y. $1,290,345. Design of a sonar system. Naval Ship Systems Command, Washington, D.C. N00024-1-C-1046.

8—United Aircraft Corp., East Hartford, Conn $1,876,429. Engine spare parts to support J-57P4A, 10, 16, 20 and 22 engines used on F-8 and A-3 series aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-0-69000A-AG701.

—Sperry Rand Corp., Long Island, N.Y. $1,626,000. Design and development of two pre-production Interface Adapter Units, with spare parts and a computer program Great Neck, N.Y. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5366.

9—Johns Hopkins University, Silver Spring, Md. $3,192,800. Advanced research on surface missile systems Naval Ordnance Systems Command, Washington, D.C. NOw 62-0604.

—General Electric Co., Washington, D.C. $$2,056,700. Two gas turbine shipboard engines, plus installation and testing. Cincinnati, Ohio. Naval Ship Systems Command, Washington, D.C. N00024-69-C5331.

—ARINC Research Corp., Annapolis, Md. $1,324,431. System effectiveness/cost effectiveness study program of the P-3C avionics system. Naval Air Systems Command, Washington, D C. N00019-70-C-0027.

10—Collins Radio Co., Cedar Rapids, Iowa. $3,000,000. Submarine emergency communication transmitters. Naval Electronic Systems Command, Washington, D.C. N00039-70-C-1504.

—American Electronics Inc., Fullerton, Calif. $1,142,049. Motor generator sets. Headquarters, Marine Corps, Washington, D.C. M00027-70-C-0022.

11—American Machine and Foundry Co., York, Pa. $1,776,170. Mk 82 Mod 1 bomb bodies. Ships Parts Control Center, Mechanicsburg, Pa. N00104-70-C-A021.

—Sperry Rand Corp., Syosset, N.Y. $1,200,000. Installation, maintenance, modification as necessary, and personnel training services in connection with navigational systems, including Ships Inertial Navigation System, aboard research, oceanographic and special vessels. Naval Regional Procurement Office, Brooklyn, N.Y. N00140-70-C-0202.

12—General Dynamics Corp., Pomona, Calif. $4,281,864 (contract modification). Procurement of Standard ARM missiles for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0336.

—PRD Electronics, Inc., Jericho, N.Y. $11,191,500 (contract modification) Versatile Avionics Shop Test (VAST) stations for F-14A avionics. Naval Air Systems Command, Washington, D.C. N00019-69-C-0334.

—Raytheon Co., Wayland, Mass. $23,109,600. Engineering development of the NATO Sea Sparrow surface missile system. Naval Ordnance Systems Command, Washington, D.C. N00017-70-C-4409.

16—Sperry Rand Corp., Syosset, N.Y. $12,390,056. C-3 Poseidon inertial navigation subsystem equipment for fleet ballistic missile submarines, and training and spare parts. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5007.

—Western Electric Co., New York, N.Y. $1,950,380 (contract modification). Oceanographic research. Whippany, N.J. Naval Electronic Systems Command, Washington, D.C. N00039-69-C-3508.

17—Ryan Aeronautical Co., San Diego, Calif. $12,500,000. BQM-34E aerial target systems. Naval Air Systems Command, Washington, D.C. N00019-69-C-0693.

—General Dynamics Corp., Pomona, Calif. $9,964,690. Standard ARM missiles. Naval Air Systems Command, Washington, D.C. N00019-68-C-0074.

—Grumman Aerospace Corp., Bethpage, N.Y. $2,300,000 (contract modification). Long lead time effort and materials for EA-6B aircraft. Naval Air Systems Command, Washington, D.C. N00019-67-C-0078.

—Interstate Electronics Corp., Anaheim, Calif. $1,761,218. Poseidon missile test and evaluation instrumentation. Naval Strategic Systems Project Office, Washington, D.C. N00030-68-C-0309.

—RCA, Moorestown, N.J. $1,695,000. Digital range units for Advanced Range Instrumentation Ships (ARIS) in support of the Pacific Missile Range. Naval Purchasing Office, Los Angeles, Calif. N00123-70-C-0436.

—Goodyear Tire and Rubber Co., Akron, Ohio. $1,410,068. 4,015 fuel cells with baffles for amphibious landing vehicles. Hq., Marine Corps, Washington, D.C. M00150-70-C-0108.

18—Collins Radio Co., Newport Beach, Calif. $10,714,950 VLF radio receivers and transmitters. Naval Electronics Systems Command, Washington, D.C. N00039-70-C-1507.

19—Grumman Aerospace Corp., Bethpage, N.Y. $9,000,000 (contract modification). Long lead time effort and materials for A-6A aircraft production. Naval Air Systems Command, Washington, D.C. NOw 66-0058.

—Singer-General Precision Inc., Little Falls, N.J. $3,870,940. Inertial measurement units and adapter power supplies for A-7E aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-68-A-3201-0174.

—RCA, Camden, N.J. $2,663,394 (contract modification) Operation and maintenance of the Atlantic Fleet Range Support Facility for 12 months. Naval Air Systems Command, Washington, D.C. N00019-67-C-0341.

—General Electric Co., Schenectady, N.Y. $53,650,000 (contract modification). Nuclear reactor compartment components. Naval Ship Systems Command, Washington, D.C N00024-67-C-5321.

—Hughes Aircraft Co., Fullerton, Calif. $2,701,670. Engineering study on passive sonar equipment. Naval Ship Systems Command, Washington, D.C. N00024-70-C-1069.

—Northrop Corp., Norwood, Mass. $1,218,010. Repair of 120 gyroscopes. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5116.

22—The Naval Ships Parts Control Center, Mechanicsburg, Pa., issued the following contracts for bomb bodies, Mk. 82 Mod 1:

American Machine and Foundry Co., York, Pa. $40,072,164. N00104-70-C-A027.

United States Steel Corp., Pittsburgh, Pa. $39,637,188. McKeesport, Pa. N00104-70-C-A032.

American Manufacturing Co. of Texas, Fort Worth, Tex. $39,555,630. N00104-70-C-A028.

Norris Industries, Los Angeles, Calif $34,598,400. N00104-70-C-A031.

—American Electric Inc., La Mirada, Calif $1,499,425. Mk 87 Mod 1 practice bombs Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-70-C-A009.

—Honeywell, Inc., Hopkins, Minn. $1,916,716. Lots 1-13 of Mk 46 Mod 1 torpedoes. Naval Ordnance Systems Command, Washington, D.C. N00017-67-C-1102.

—United Aircraft Corp., East Hartford, Conn. $2,520,033. TF-30P6/P8 engine spare parts for A7A/B aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-0-69000A-AG729.

23—General Dynamics Corp., Pomona, Calif $24,008,312. Standard ARM missiles Naval Ordnance Systems Command, Washington, D.C. N00017-67-C-2107.

—Akwa-Downey Construction Co., Milwaukee, Wis. $4,855,771. Construction of a VLF antenna and grounding system, Naval Radio Station, Lualualei, Hawaii. Naval Facilities Engineering Command, Washington, D.C. N62471-69-C-0314.

—The Johns Hopkins University, Silver Spring, Md. $2,935,100. Increased level of effort for advanced research on surface missile system. Naval Ordnance Systems Command, Washington, D.C. NOw-62-0604-c.

24—United Aircraft Corp., East Hartford, Conn. $5,526,327 (contract modification). J-52-P-8A engines. Naval Air Systems Command, Washington, D.C. N00019-67-C-0182.

—Lockheed Aircraft Corp., Marietta, Ga $5,148,048. Services and materials necessary for progressive rework on C-130 series aircraft. Naval Air Systems Command, Washington, D.C. N00019-70-C-0153.

—Bendix Corp., Baltimore, Md. $2,219,310. Receiver transmitters and associated equipment for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. NOw 66-0637.

—Yardney Electric Corp., New York, N.Y. $2,619,000. Production of Mk 46 Mod 1 batteries, Pawcatuck, Conn. Naval Ordnance Systems Command, Washington, D.C. N00017-70-C-1404.

—Bendix Corp., Teterboro, N.J. $1,215,000. Programmed adaptors for use with the AN/GSM-133 automatic test set used on F-4 series aircraft missile control, navigation, identification and communication systems. Naval Purchasing Office, Los Angeles, Calif. N00123-70-C-0510.

25—Grumman Aerospace Corp., Bethpage, N.Y. $8,600,000 (contract modification). Incremental funding for E-2C aircraft Naval Air Systems Command, Washington, D.C. N00019-68-C-0542.

—General Signal Corp., Woodbury, N.Y. $1,702,360. Radar equipment. Naval Air Systems Command, Washington, D.C. N00019-70-C-0111.

—North American Rockwell Corp., Anaheim, Calif. $1,360,000. Modification, improved calibration techniques and design of Ships Inertial Navigation Systems. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5156.

26—Curtiss-Wright Corp., Wood-Ridge, N.J. $4,589,480. Modification kits for conversion of J-65-W-16A engines to -20 configuration. Naval Aviation Supply Office, Philadelphia, Pa. F41608-69-A-0057.

29—Curtiss-Wright Corp., Wood-Ridge, N.J. $1,788,308. Modification kits for J-65 engines used in A-4 series aircraft Naval Aviation Supply Office, Philadelphia, Pa. F41608-69-A-0057.

—EFMC Corp., Compton, Calif. $1,084,512 Mk 19 Mod 1 plastic windshields for 3-inch 50 caliber twin gun mounts. Naval Ordnance Station, Louisville, Ky. N00197-70-C 0156.

—The Naval Air Systems Command, Washington, D.C., issued the following contracts:

Sperry Rand Corp., St. Paul, Minn. $6,155,325. CP-901/ASQ-114 computers. N00019-70-C-0110

Beech Aircraft Corp., Wichita, Kan. $5,994,558. AQM-37A missile targets. Boulder, Colo. N00019-70-C 0142.

Sundstrand Corp., Rockford, Ill. $3,105,804 (contract modification). Constant speed drives for F-4E, RF-4E and F-4J aircraft. N00019-68-C-0083.

Garrett Corp., Phoenix, Ariz. $1,474,200. T76-G-410-411 turboprop engines and containers. N00019-70-C-0063.

30—Intercontinental Manufacturing Co., Garland, Tex $16,444,840. Mk 82 Mod 1 500-pound bomb bodies. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-70-C-A030.

—Borg-Warner Corp., Chicago, Ill. $15,586,028. Mk 82 Mod bomb bodies. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-70-C-A029.

—General Motors Corp., Indianapolis, Ind. $3,437,100. Provisioning kits for T56 engines. Naval Aviation Supply Office, Philadelphia, Pa. F34601-69-A-2021.

DEPARTMENT OF THE AIR FORCE

2—General Electric Co., Cincinnati, Ohio. $1,500,000. Engineering effort and services to improve components of the TF-39 aircraft engine. Evandale, Ohio. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-67-C-1221.

3—Northrop Corp., Hawthorne, Calif. $8,684,640. T-38A aircraft, spare parts and aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0216.

—The Boeing Co., Seattle, Wash. $3,761,710. Production of electronic test equipment for Minuteman III weapon system. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F04606-69-A-0171-QP61.

—Lockheed Aircraft Services, Inc., Jamaica, N.Y. $3,700,000. Modification and maintenance of special air mission aircraft. Oklahoma Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-70-C-0240.

4—The Boeing Co., Seattle, Wash. $2,570,887. Design, development and test of Minuteman III weapon system additives. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF04(694)-791.

5—General Electric Co., Philadelphia, Pa. $6,000,000. Low angle re-entry flight test program. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0157.

—Cessna Aircraft Co., Wichita, Kan. $3,000,000. A-37B aircraft, spare parts and aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0018.

—Lockheed Aircraft Corp., Marietta, Ga. $1,218,480. Spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF33(657) 15053.

—Dynamics Corp. of America, Bridgeport, Conn. $5,014,118 Production of diesel generator sets, MB-15, -16, -17, -18, and -19. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-68-D-0575.

8—The Boeing Co., Seattle, Wash $19,819,000. Procurement of Minuteman missiles. Seattle and Clearfield, Utah. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0165.

—General Electric Co., Cincinnati, Ohio. $1,020,000 Procurement of T-64 engine mobile test stands. Evandale, Ohio. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-68-C-0787.

10—Cessna Aircraft Co., Wichita, Kan. $2,695,000. Modification of T-37B aircraft. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-70-C-0566.

—IBM, Gaithersburg, Md. $2,124,000. Design of airborne and ground electronics equipment. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-69-C-0046.

—Texas Instruments, Inc., Dallas, Tex. $2,504,619. Production of airborne radar equipment for RF-4 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0251.

—Lockheed Aircraft Corp., Marietta, Ga. $1,379,221. Aerospace ground equipment for C-5A aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson, AFB, AF33(657)-15053.

11—ITT Research Institute, Chicago, Ill. $4,680,200. Operation of an electromagnetic compatibility analysis center. Annapolis, Md. Electronics Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-69-C-0073.

—United Aircraft Corp., East Hartford, Conn. $1,820,000. Conversion of TF-30-P-12A engines to TF-30-P-7 configuration. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. N383-69000A.

12—General Dynamics Corp., San Diego, Calif. $2,151,002 Models 3A and 3C standard launch vehicles (Atlas boosters). Space and Missiles Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0001.

—TRW Systems Group, TRW, Inc., Redondo Beach, Calif. $1,006,020. Technical services for Minuteman II and III propulsion systems. Norton AFB, Calif. Space and Missile Systems Organization, Los Angeles, Calif. F04701-70-C-0101.

—Bendix Corp., Teterboro, N.J. $1,125,558. Navigational computer system components (AN/ASN-46A) for F-4 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0329.

15—General Electric Co., West Lynn, Mass. $2,180,000. Spare parts for J-85 aircraft engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F34601-69-D-2254.

—General Electric Co., Cincinnati, Ohio. $3,700,000. J-79 aircraft engine components. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-A-1029.

—The Boeing Co., Seattle, Wash $1,243,000. Removal and replacement of modified Minuteman missiles. Malmstrom AFB, Mont., Whiteman AFB, Mo., and Grand Forks AFB, N.D. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0232.

—Lear Siegler, Inc., Santa Monica, Calif. $4,039,609. A/A37G-3 flight control systems components for BQM-34 and MQM-34 target missiles. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0340.

—International Telephone and Telegraph Corp., Nutley, N.J. $1,198,387. Organization and field level maintenance, and training services in support of the Strategic Air Command Automated Control System, Omaha, Neb., Bossier City, La., Riverside, Calif., Chicopee Falls, Mass., and Nutley. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-70-C-0526.

17—Litton Systems, Inc., Woodland Hills, Calif. $9,645,975. Repair of gyroscopes for the F-4 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F04606-69-A-0203 SD39.

—Thiokol Chemical Corp., Brigham City, Utah $10,200,000. Production of stage 1 motors for Minuteman III missiles. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0197.

18—Sargent-Fletcher Co., El Monte, Calif. $3,827,656. Fuel tank assemblies for F/RF-4 series aircraft. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F042600-69-D-0226-0001.

—Lockheed Aircraft Corp., Marietta, Ga. $1,699,011. Spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF33(657)15053.

—Singer-General Precision, Inc., Binghamton, N.Y. $1,655,592. Design, develop, fabricate, test and install A/F37A-T-40 trainer, spare parts and aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0013.

—Westinghouse Electric Corp., Baltimore, Md. $3,500,000. Production and test of four Air Traffic Control Sets (AN/GPS-6), spare parts and support data. Electronic Systems Division, AFSC, L.G. Hanscom Field, Mass. F19628-70-C-0049.

22—Space Corp., Garland, Tex. $8,042,550. Turbo-prop and turbojet engine test stands. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-70-C-6472.

—Goodyear Aerospace Corp., Akron, Ohio. $1,000,000. Mobile armament recording camera. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0297.

—General Dynamics Corp., Fort Worth, Tex. $3,547,800. Production of F-111 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. AF33(657)-13403.

23—Texas Instruments, Inc., Dallas, Tex. $2,390,000 Components for airborne infrared detecting equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0286.

24—General Dynamics Corp., Fort Worth, Tex. $31,942,183. Supplemental agreement for production of F-111 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. AF33(657)13403.

—The Boeing Co., Seattle, Wash. $18,790,189. Force modernization of Minuteman Wing III, Minot, N.D. Space and Missile Systems Organization, Los Angeles, Calif. F04701-68-C-0042.

25—General Electric Co., West Lynn, Mass. $1,927,400. Production of J-85 and T-58 engines. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0005.

—REDM Corp., Wayne, N.J. $1,223,738. Component parts for general purpose bombs. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-0439.

—J. A. Maurer, Inc., Long Island City, N.Y. $1,278,241 Cameras and component parts for RF-5 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0876

26—McDonnell Douglas Corp., Tulsa, Okla. $1,770,964. Modification and maintenance of B-52 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker, Okla. F34601-69-C-0009.

29—Lockheed Aircraft Service Co., Midwest City, Okla. $1,206,000. Repair and modification of F-84 series aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-4414-0004 AA.

—Dynalectron Corp., Fort Worth, Tex. $1,726,000. Corrosion control for various aircraft. Kadena AB, Okinawa. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F3460-69-D-4415

—North American Rockwell Corp., Anaheim, Calif. $71,472,280. Minuteman III guidance and control systems. Space and Missile Organization, AFSC, Los Angeles, Calif. F04701-68-C-0174.

30—Emerson Electric Co., St. Louis, Mo. $5,107,000. Electronic test equipment for C-141, RF-4C and F-111 aircraft avionic systems. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-70-C-6020.

—North American Rockwell Corp., Anaheim, Calif. $14,308,300. Design and fabrication of depot maintenance ground equipment and factory tooling and test equipment in support of Minuteman III guidance and control systems. Space and Missile Systems Command, AFSC, Los Angeles, Calif. F04701-69-C-0129.

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DCS-Mallard Interface Task of Study Group

Analysis of the interface between the Defense Communications System (DCS) and tactical communications systems using equipment developed by Project Mallard is the task of a working group established by the Defense Communications Agency (DCA).

The new DCA-Mallard Interface Technical Working Group (ITWG) will identify problems, develop alternative solutions, and make recommendations to the Director of DCA and the U. S. Manager of the Mallard Project. Overall objective of the ITWG is to assure a cost-effective interface between DCS and tactical communications systems using Mallard-developed equipment.

Project Mallard was initiated in 1965 as an international cooperative program to develop a secure digitally switched tactical communications system common to the four member nations, the United States, Australia, Canada and the United Kingdom.

DCA is responsible for management control and direction of the worldwide DCS, operated by the three Military Services.

Air Force Begins Field Tests of Air Mobile Bases

In Air Force logistics, mobility means moving an entire air base, from runway lights to barracks, in a hurry. And to the Aeronautical Systems Division (ASD), AFSC, Wright-Patterson AFB, Ohio, that means a system of lightweight and durable air transportable equipment that can be ready for use hours after reaching a new base site.

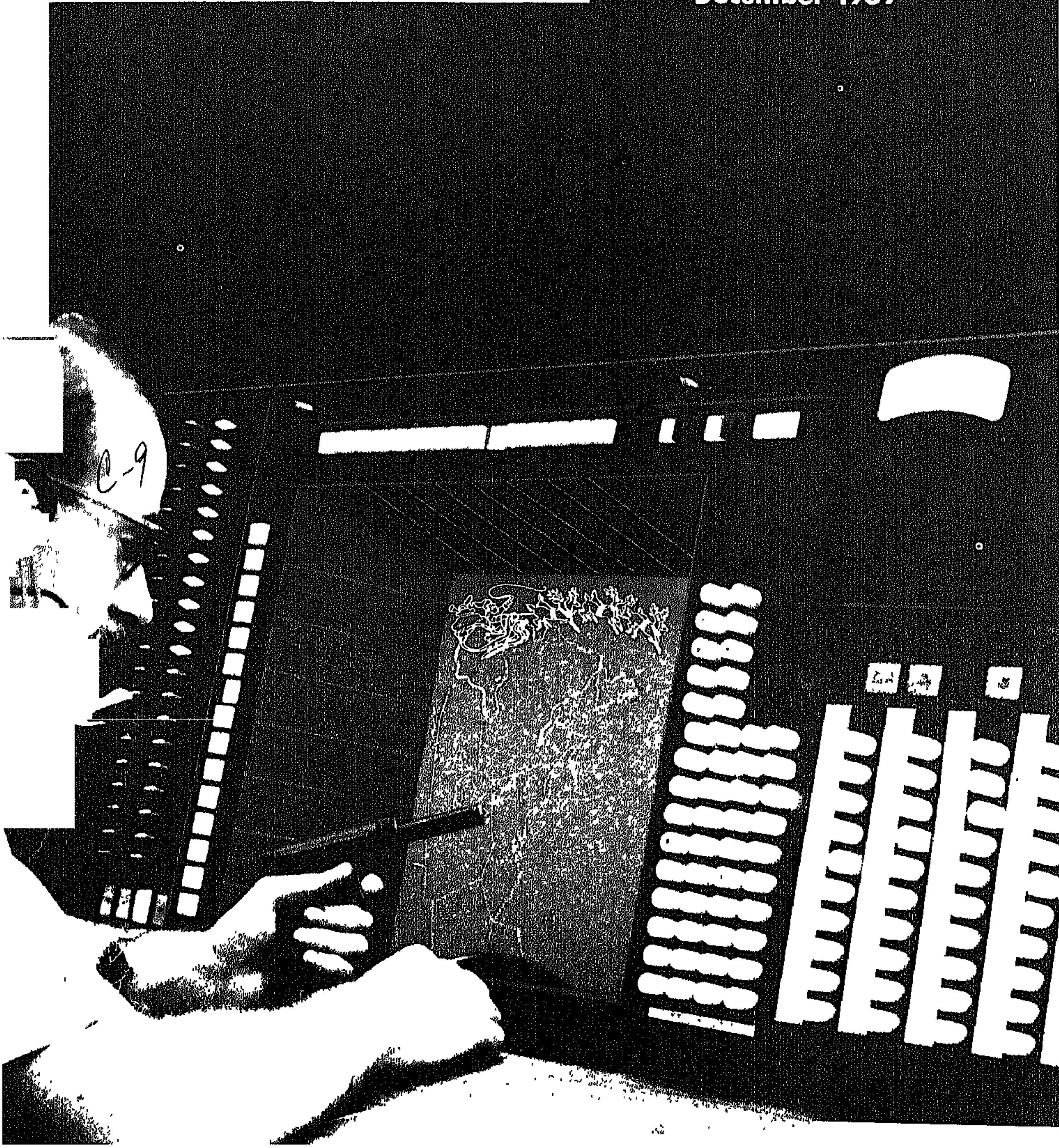
ASD's Air Mobility Program Office, headed by Lieutenant Colonel Donald D. Klein, has the responsibility for assembling and testing the 2,700 items in the "bare base" concept. The first phase of field tests to demonstrate this concept are scheduled to begin this fall.

Equipment developed and procured for the tests include:

- Expandable shelters to serve as maintenance shops, kitchens or sanitary facilities. The units are constructed of aluminum frames, with polyurethane foam-filled siding.
- Aircraft hangars, each capable of housing an F–4, and requiring 160 man-hours to erect.
- Personnel shelters for 11 to 20 individuals.
- Airfield lighting, including approach, runway and taxiway lights, glide angle indicator and beacon.
- An electrical distribution system providing complete electrical power for a bare base of nearly 600 shelters. With a 4,160 volt primary system, it is stepped down to 60 cycle, 110-208 volt power for the user.
- A gas turbine powered liquid oxygen and nitrogen generator, with a capacity of two tons per day.
- Two heating systems, a 60,000 BTU per hour system for living and working spaces, and a 400,000 BTU per hour system for hangars and large working spaces.
- Kitchens, with a 250 meal per hour capacity, a water distribution system and sanitary facilities.
- Tow trailers for the logistic shelter air transportables (LSATs) and personnel shelters, compatible with the rail cargo handling systems on the C–130 and C–141 aircraft, and designed for use from aircraft to base site.

DEFENSE INDUSTRY BULLETIN

December 1969



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The *Defense Industry Bulletin* is published monthly by the Defense Supply Agency for the Department of Defense. Use of funds is approved by the Director, Bureau of the Budget.

The *Bulletin* serves as a means of communication between the Department of Defense, its authorized agencies, defense contractors and other business interests. It provides guidance to industry concerning official DOD policies, programs and projects and seeks to stimulate thought on the part of the De-[illegible] the defense effort.

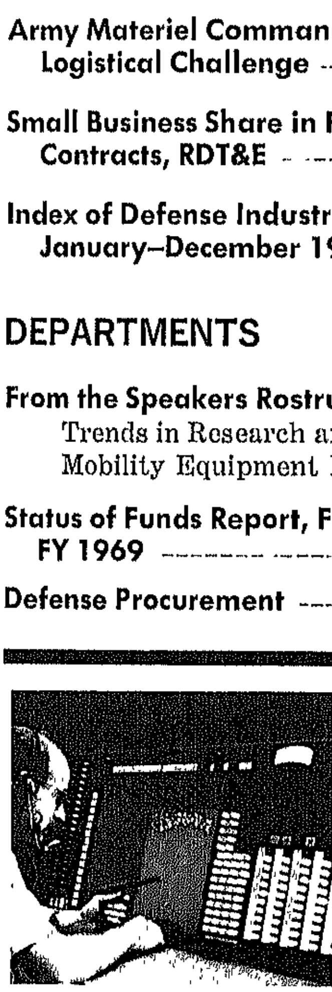
Suggestions [illegible] are welcome and [illegible] forwarded to [illegible] address [illegible].

[illegible] distributed [illegible] to qualified [illegible] of industry [illegible] the Departments of [illegible], Navy and Air Force. Subscription [illegible] should be [illegible] on company letterhead, must indicate the title of the requester, and be addressed to: Editor, Defense Industry Bulletin, [illegible] Defense Supply Agency (DSAH-B), Alexandria, Va. 22314.

IN THIS ISSUE

FEATURES

DEPARTMENTS



Back-Up Interceptor Control centers furnish air defense commanders with current information about airborne targets in their areas of control. A stand-by, high-speed computerized monitor system, BUIC was developed by the AFSC Electronic Systems Division whose story begins on page 1.

Electronic Systems Division

Command, Control, Communications Systems—"Musts" in Modern Weaponry

Major General Joseph J. Cody Jr., USAF

Today, communication is the basis of existence of any organized effort. This is certainly true in the Armed Forces and, specifically, in the Air Force where we regard it as a great necessity—in fact we are built upon it.

Coming into focus, more and more, is the association of communications and command and control in the military enterprise. Indeed, the transfer of information within the Air Force is growing. It is growing because we have been provided with the capability of being able to handle and manipulate large amounts of data and related items. We have been provided machinery which has extended our ability to function, far more than we ever were able to do.

Our military operations, in this time period, are highly complex operations involving ultra-sophisticated and very expensive equipment. We have to be certain that we use this machinery so as to optimize it. Common sense dictates that we not buy copies of everything we want, and that we find ways of being more efficient in the use of what we have. Underlying that thesis is what we call command and control and communication in the Air Force.

In the Air Force technical community the problem of designing and acquiring systems for command and control and communication resides at the Electronic Systems Division.

The Electronic Systems Division (ESD) of the Air Force Systems Command was created from several previous organizations on April 1, 1961. Its mission is to manage the development, acquisition, installation and test of electronic command, conrol and communication systems for the Air Force and other agencies of the Defense Department.

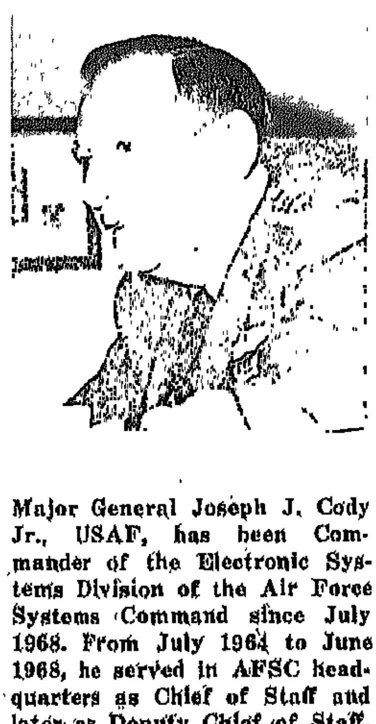
Since its establishment eight years ago, ESD has played major roles in nearly every Air Force function which requires fast and accurate command and control. And, when you add communication to this activity then, in essence, ESD finds itself in essentially all kinds and types of military activity.

In this country, technological efforts over the past few years have been tremendous. There has been a rapid surge in the use of computers, data handling, microelectronics, new applications, and in a host of other areas. In fact, there is hardly any area where the state of the art has not significantly advanced.

Command, control and communication, in one sense, is a sort of glue which binds everything within a system together. There are probably deep within the design of a system such things as the ability to enhance weapon system effectiveness in terms of their application, or maybe tradeoffs between the numbers of systems and our efficient use of them.

It is not a simple concept. There are no written specifics and numbers which state categorically that we can make a tradeoff. There is, though, a relationship between the effectiveness of our weapon systems and the effectiveness of the control environment in which we have to operate.

The state of the art actually allows us to have a surplus of information.



Major General Joseph J. Cody Jr., USAF, has been Commander of the Electronic Systems Division of the Air Force Systems Command since July 1968. From July 1964 to June 1968, he served in AFSC headquarters as Chief of Staff and later as Deputy Chief of Staff, Systems. Before that he was assigned as Commander of the 6595th Aerospace Test Wing at Vandenberg AFB, Calif. General Cody holds a B.S. degree in physics from St. Mary's University, San Antonio, Tex.

Coupled with this great wealth of information is the real problem of how to cope with it. Our technical know-how can actually produce so much data that we have trouble assimilating it. The problem is double-faced—either we overapply or underapply this information.

As technicians, we at ESD have to recognize and be governed by certain economic considerations. We have to weigh all factors before actually buying a component, a link, or a complete system.

The disciplines and the military missions are merging, and in so doing are creating planning problems. For example, the communications satellite is not selective—it cannot distinguish between tactical and strategic data, and so missions are crossed.

Organization

Located at Hanscom Field, Bedford, Mass., near Boston, ESD is the headquarters for a worldwide organization with detachments and field offices in Europe and Asia.

Approximately 10,000 civilians and military personnel make up a work force which embraces other attached military organizations, federally funded laboratories, a not-for-profit corporation, and private industry groups. In total, the group is commonly called the Hanscom Complex.

ESD is responsible for the evaluation, procurement and production of radar, computers, displays, software (including computer programs), management and production plans. It also supervises quality control, installation and checkout of systems.

Management

The missile age, which called for increased emphasis on command and control, also caused a revolution in management and the end of traditional management methods.

By the early 1950s, with technology already at a gallop and the Soviets possibly as much as several years ahead of us in the development of a strategic missile program, we found ourselves confronted with a number of questions that our management procedures were unable to answer.

Time was at a premium. Design of equipment, scheduling of production, training of field personnel, stocking of spare parts, construction of sites, and a multitude of other factors all had to be dealt with concurrently, rather than one after the other as in the past.

Technology also was a crucial factor. There were many unresolved questions and a short fuse on the amount of time to get answers. It was crystal clear that management and not technology would determine the pace of America's progress.

The answer which has evolved today is management of systems as total integrated packages.

At ESD each electronic system is handled as a complete package by a system program office (SPO). These come under the jurisdiction of offices called deputies or directorates and cover such general areas as civil engineering, communications, surveillance and control, tactical, planning and technology, and foreign technology.

Functions of the SPO are to create the particular program and follow it closely all the way through its development; determine the hardware and facilities needed; issue contracts to industry; and manage the system to its final operational phase and turnover to the using command.

While shaping an electronic system, ESD personnel recognize that it is a basic policy and law that the Government must make its own procurements by competition, whether advertised or negotiated. Within most SPOs is a procuring contracting officer who is rigidly governed by the Armed Services Procurement Regulation and Air Force Procurement Instructions.

The contracting officer has the authority to represent the Government with contractors, and is the only one with the power to "authorize or direct" changes, or to discuss information which pertains to new programs or contemplated procurements.

An electronic system is much more than a collection of black boxes. Much more is involved for command and control systems.

Before some systems are truly in working order, ESD must add information to the electronic machinery. This facet of operations, commonly called "software," includes formulation of computer programs which instruct machines to handle the information, and procedures for operator personnel to follow.

A vital link in the chain of successful guidance of complex systems, from the drawing board to the final operational phase, is that aspect referred to as the concept of concurrency.

The concept of concurrency is a common sense approach to a situation which says that precious time in building a system need not be wasted, if logistic support is planned well in advance for all elements and phases of the system. Instead, time is compressed so that each part of the overall project under construction proceeds on a time schedule which is geared to the ultimate completion of the entire system.

Systems management at ESD is conducted in accordance with AFSC's Manual 375 series of regulations. These regulations, authored in part by the military-civilian staff at ESD, are still valid after their acceptance six years ago. The majority of systems acquisitions here are conducted in accordance with the 375 series.

It might be pertinent to point out here that ESD has a number of programs, particularly its Southeast Asia programs, where the operational due date for the systems is so short that it precludes using the standard 375 approach.

At ESD we feel that we have by no means reached the end of the evolution in management. The challenges of the future may call for further innovations. These innovations are not to be feared, but welcomed.

Policy

As the lead division within the Air Force Systems Command for the design and acquisition of command, control, and communications-electronic systems for aerospace forces, ESD maintains an in-house checks and balance system so that its administrative and scientific resources are utilized to the utmost. The goal is qualitatively superior systems.

In producing electronic systems with a high order of effectiveness, ESD coordinates and oversees the activities of many organizations. The division, for example, does not have a separate computer effort or a separate communications effort and, instead, relies upon others who operate independently. They are separate in that there is a technical discipline

ELECTRONIC SYSTEMS DIVISION

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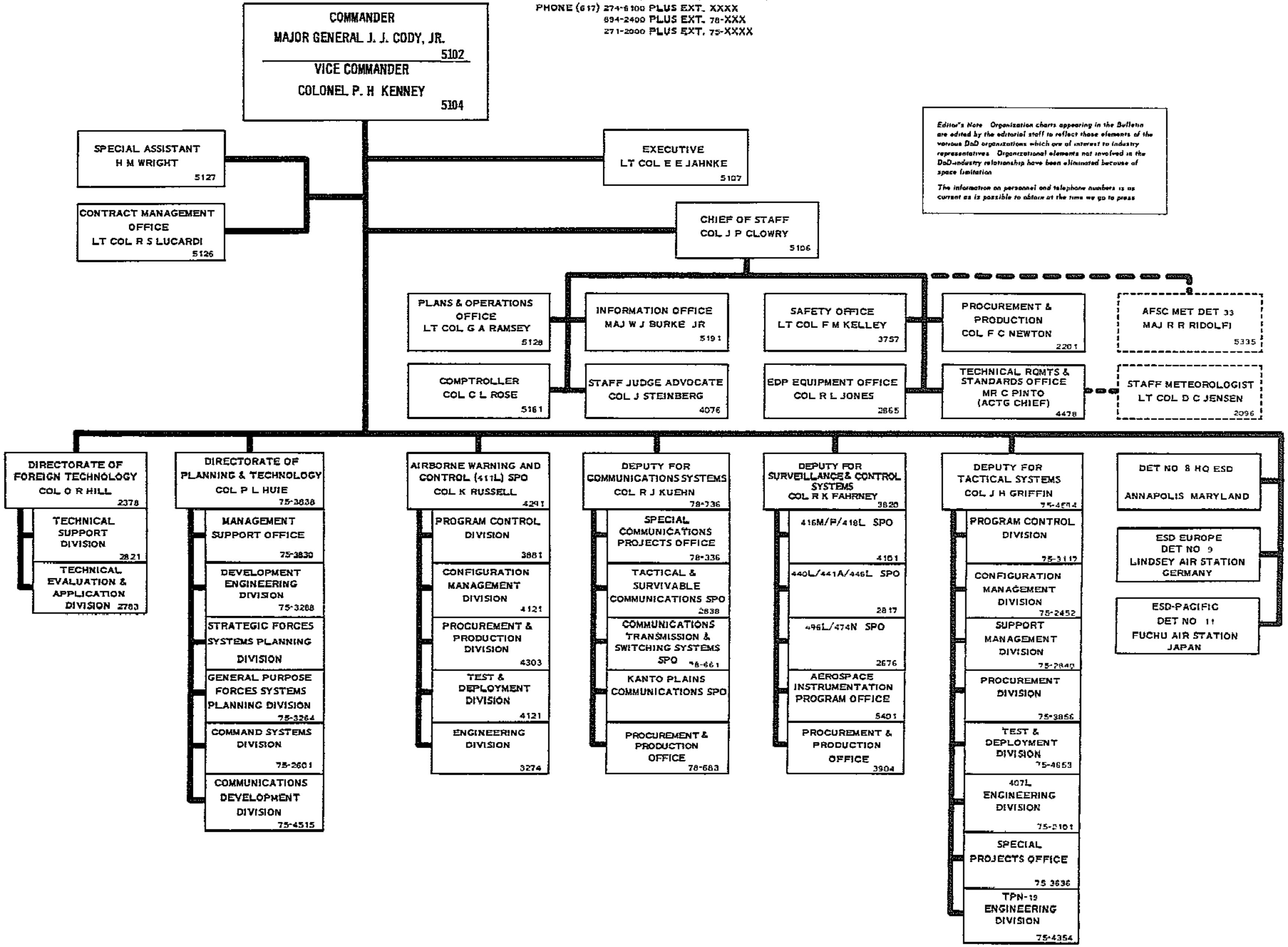


Editor's Note Organization charts appearing in the Bulletin are edited by the editorial staff to reflect those elements of the various DoD organizations which are of interest to industry representatives. Organizational elements not involved in the DoD-industry relationship have been eliminated because of space limitation.

The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.

that makes sense for them to be handled separately. But, in terms of work that is produced, they all come together as part of a cohesive whole.

Several organizations have a major role in producing electronic systems and their development. At the top of this list is the MITRE Corp. This civilian, not-for-profit corporation is under contract to the Air Force to provide ESD with systems engineering and technical support.

A key supporting agency within the AFSC family is the Rome Air Development Center, located at Griffiss AFB near Rome, N.Y. This laboratory is oriented toward equipment, rather than to systems as a whole.

Located at Hanscom Field is the Lincoln Laboratory, supported by the Air Force, the Advanced Research Projects Agency, and the National Aeronautics and Space Administration. Its work is principally in electronics, with emphasis on applications to national defense and space exploration.

Also located at Hanscom Field is the Air Force Cambridge Research Laboratory, under the Office of Aerospace Research, with a mission to conduct research in the physical, environmental and mathematical sciences. Staff members serve largely as consultants to ESD and accomplish some direct engineering in weather systems.

Programs and Systems

Electronic command, control, and communication systems fall into general categories such as tactical, strategic, surveillance, weather observing and reporting, air traffic control, navigation, identification, weapons, defense and communications.

A typical electronic command and control system has four functions—to collect, transmit, process and display information. It has sensors of one form or another to collect information, communications lines of all types to transmit the information, computers to process and store data, and equipment to display the gathered data and present it to a commander in a form so that he can plan, direct and control his forces.

Some of the more important and easily identifiable systems which come under the jurisdiction of ESD deputies or directorates follow.

Deputy for Surveillance and Control Systems

This ESD office manages the sensor systems, such as radar, which in reality are the eyes and ears of the command systems. These sensors gather data on missiles, aircraft activities, space objects, weather, intelligence and the control systems that help in the execution of command decisions.

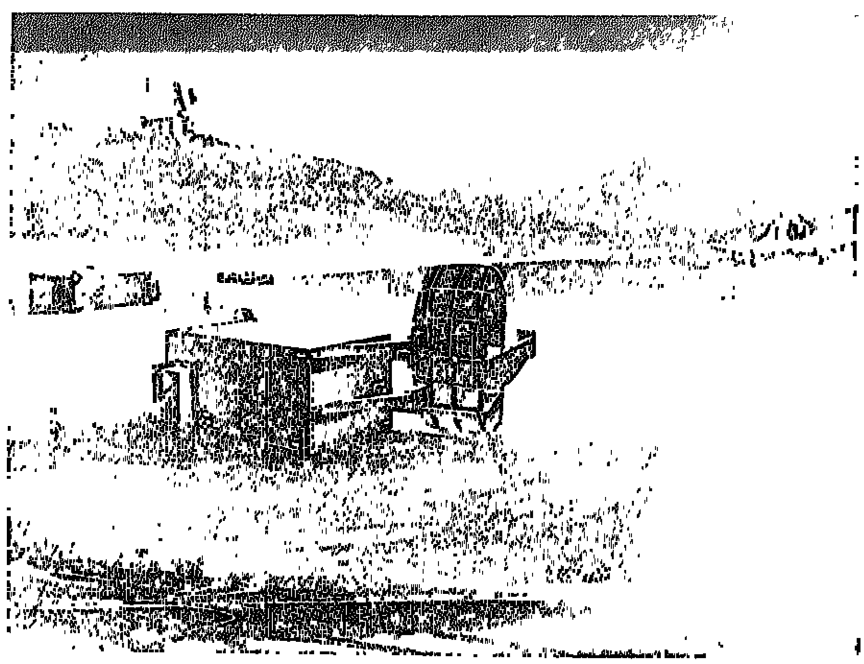
Systems which were developed under the jurisdiction of this deputy, or its predecessor, are the basic Semi-Automatic Ground Environment (SAGE) effort which divided the nation into air defense sectors with a direction center in each sector, utilizing computers which processed data and allowed commanders to follow a battle situation and direct air defense weapons; the Ballistic Missile Early Warning System (BMEWS) with radar sites which fed their information into the SAGE centers; and the Back-Up Interceptor Control (BUIC) system which are dispersed centers in support of SAGE.

Under this deputy, ESD has a most interesting effort underway in the planning for an advanced airborne command post. This system will utilize an existing large aircraft and would be used by the National Command Authority, as well as the commanders of unified and specified commands responsible for directing forces during a nuclear war.

Another significant program about to go into contract definition is the Airborne Weather and Reconnaissance System (AWARS). When operational, this system will provide the Air Force Weather Service with a substantially increased capability to collect, process and relay meteorological data to selected ground stations on a global basis.

A potentially large effort for ESD over the next few years under this deputy will be the update of the Worldwide Military Command and Control System.

ESD, which developed command and control systems for the North American Air Defense Combat Operations Center at NORAD, also pioneered in the development of the SPACETRACK system which keeps track of all objects in space and reports its findings to the North American Air Defense Command (NORAD).



LANDING CONTROL CENTRAL AN/TPN-19 tactical communications and control system is now under development. The artist's rendition shows precision approach radar in the foreground, operations center housing traffic controllers to the left, and airport surveillance radar on the hill in the background. All units of the AN/TPN-19 system will collapse into standard size mobile vans for easy transport by truck, helicopter, or aircraft.

Γhe deputy is also responsible for : support provided the National nge Division of AFSC, with test ıges at Cape Kennedy in Florida d Vandenberg AFB, Calif.

An example of this type of support A/RIA, the Apollo Range Instruntation Aircraft. This fleet of spelly instrumented C–135A aircraft ›vide two-way voice communicans between the aircraft and space-ıft and, in turn, between the air-.ft and the Manned Spaceflight nter in Houston to record telemetry ormation from the spacecraft.

Deputy for Tactical Systems

Currently under development are a mber of systems which service the tical forces. The equipment in se systems is of wide variety and it omplishes the functions of air con-l and warning, command and com-nications, air traffic control, and ect air support.

Γhe tactical environment is wing more involved and complex. e enemy moves quickly, he is elue, and his lightning strikes are ttered over a wide area. Air power st react on a moment's notice in port of ground troops.

Γhe challenge to get to the comnder real-time tactical information the challenge of the Deputy for ctical Systems.

Largest among the many systems der development is the 407L acquiion program which produces var-s ground electronic elements to re-ce obsolete equipment. The 407L gram features modular equipment signed for mobility and deployment aircraft, helicopter and truck.

Although the 407L program is an olutionary program, ESD is already olved in planning the next genera-n tactical command and control stem. By the mid-1970s, we expect see an operational airborne tactical control system which would supment the ground elements.

Another tactical system of interest the future, and now under development by industry under contract to Air Force, is the TPN–19, nding Control Central. It is ex-cted to land present and future mil-ry aircraft more safely under the st adverse weather conditions.

In the foreseeable future the Air rce can expect to have a tactical nmand and control system which uses signals from many different sensors to provide a real-time display of the situation in the surveyed area.

Deputy for Communications

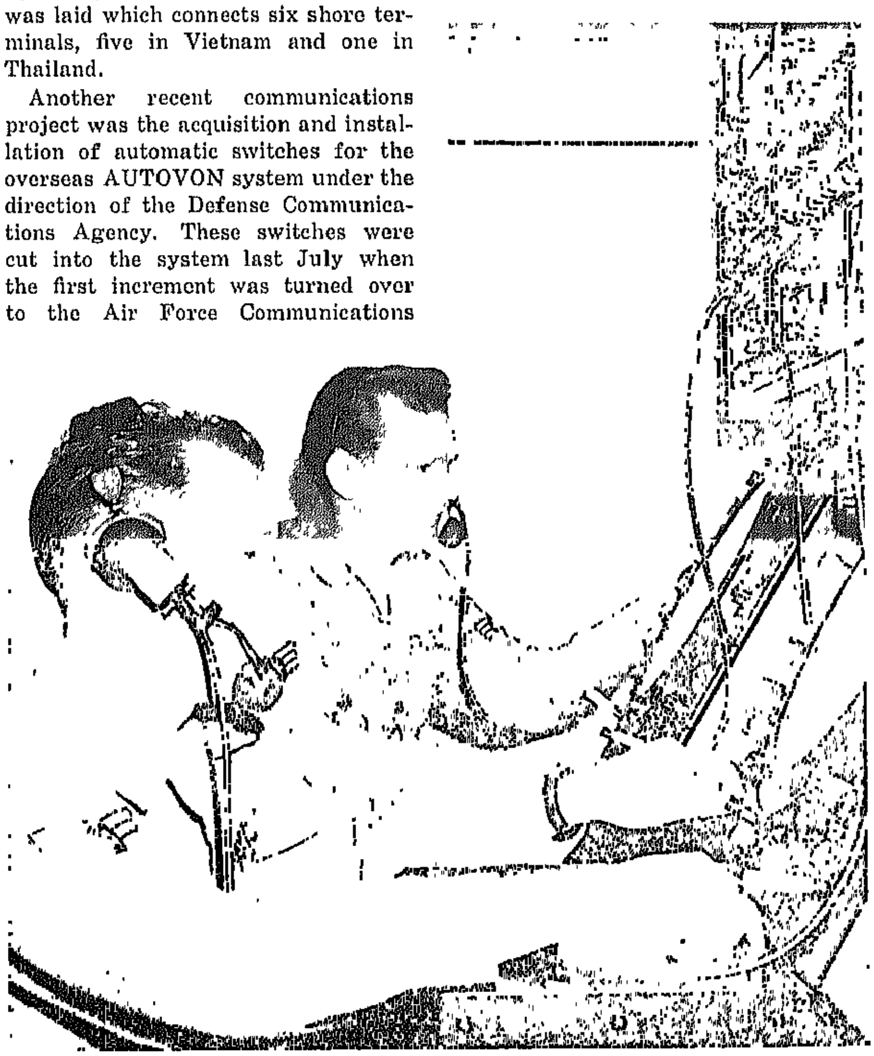
In the Armed Forces, communication is a prime requisite. The Air Force, particularly, depends on it and its function will take on more meaning in future command and control activity. In essence, communication is the vital link between the commander and the various elements in the field.

A recent effort on the part of this deputy was the implementation of the Southeast Asia Coastal Cable Communications System. Under ESD management, a 700-mile undersea cable was laid which connects six shore terminals, five in Vietnam and one in Thailand.

Another recent communications project was the acquisition and installation of automatic switches for the overseas AUTOVON system under the direction of the Defense Communications Agency. These switches were cut into the system last July when the first increment was turned over to the Air Force Communications Service. This action marked a significant step toward a worldwide military automatically switched communication network.

Looking ahead, what ESD is really faced with in the next five or six years is a total upgrading of the DCA communications system worldwide. This may necessitate further elimination of high frequency circuits, improvement in some of the strategically located troposcatter links, and the addition of satellite and undersea cable links to meet the ever-increasing demands for greater traffic flow.

The advent of satellites has provided a new and exciting mode of communication. Direct, dependable communication by voice or teletype



INTERIOR VIEW of AN/TPS–44 "two dimensional" radar operations center developed by Electronic Systems Division's 407L Tactical Air Control System. Capable of shipment by truck, ground transporter, helicopter, or cargo aircraft, the radar will be used for aircraft detection and control in forward air control posts.

with and among various small tactical units, including ships and aircraft, is of vital importance in many military operations and improved methods are constantly being sought.

The Mediterranean Communication System is a prime example of the scope of effort produced by the Deputy for Communications. The system consists of hundreds of tropospheric scatter and line of sight microwave radio terminals and relays which provide voice and teletype communications to U.S. and NATO installations in the Mediterranean and Near East areas.

Another system of a significant project is the technique called "Compass Link," a method of transmitting high resolution photographs from South Vietnam to Washington, using satellite transmission and a laser beam scanning head to reproduce the pictures for national military commanders.

Digital communications is an area of tremendous potential for the years ahead. We are already in the field of digital switching for data systems, and the outlook is for considerable growth in this area to satisfy increasing requirements for computer-to-computer links.

Airborne Warning and Control System

The Airborne Warning and Control System — acronym AWACS — represents one of the largest, most complex and challenging tasks facing ESD today and in the immediate future. Although not a pure deputy office, or a directorate, in an organizational sense, its complexity involves nearly all of the other SPOs.

Basically, the AWACS undertaking will utilize a modified version of a commercial jet transport embodying a large radar, numerous auxiliary sensors, a substantial data processing capability, and integrated command, control, and communications subsystems.

AWACS is being designed at ESD to provide a command and control capability for both continental air defense and tactical requirements.

The complexity of the radar and related data processing, display and computer engineering represents a significant step forward for the state of the art.

Directorate for Planning and Technology

The next generation of command and control systems is the main interest of the Directorate for Planning and Technology. This organization accomplishes conceptual, feasibility and cost-effectiveness studies, and establishes technical requirements and objectives that lead to assigned goals.

One such system concerning data processing for use in airborne command posts is the Post Attack Command Control System-Airborne Data Automation (PACCS-ADA) project. For this effort, a computer has been placed in an EC-135 aircraft of the Strategic Air Command to evaluate airborne electronic data processing applications for more effective control of forces.

Future Directions

Looking ahead to the mid-1970s, a further exploitation of satellites as communications feeders will undoubtedly come about.

Another point of interest for the future is the search for a better method of applying multiplexing techniques to communications.

With the growth in the use of computers, there seems to be a need for a closer association among computers and their ability to communicate with each other. There is a trend, therefore, that leads to closer integration of computers and communications.

Digital communications is another area of tremendous potential, both for the military user and the industrial contractor.

Exciting and rapid advances in technology and fabrication methods for microelectronic components now make it possible to consider new concepts.

ESD expects increased activity in the coming years in the areas of command and control for strategic operations.

New weapon systems and sensors, such as AWACS and Advanced Manned Strategic Aircraft (AMSA), will necessitate new command and control and communications concepts.

Long-range "over the horizon" radars, which can detect missiles or bombers far beyond the line of sight, will give warning of an impending attack, and will significantly reduce the number of radar sites required.

At ESD we look for reliable, survivable communications between decision centers, from the forward sensor back to the command posts and out again to the weapons. These will become a cornerstone of strategic command and control.

Increased use of satellites with higher bandwidths, power, antenna gain and jamming protection can be foreseen.

Relays, with multi-beam antennas with narrow pencil beams tracking individual mobile user terminals seem an ultimate possibility.

Unified concepts, such as the integrated communication, navigation and identification system (I-CNI), will reduce the number of avionics and will make several modes of long-range or close-range radio transmissions compatible with each other.

Modern weaponry is sophisticated and expensive. It demands, more than ever before, adequate command and control for its effective application.

We at ESD are dedicated to the purpose of trying to make these systems as efficient as possible, and to assure that they make contributions to the effectiveness of the total military operation.

ESD's story is that of taking technical and managerial skills from all available sources and uniting these to develop, design and acquire superior electronic command and control and communications systems.

The intelligent application of these capabilities and potentials is our business—that is our sole role in life.

Army Testing Detachable Tire Treads

Detachable-tread tires are under test by the U.S. Army Tank-Automotive Command, Warren, Mich. Test units have a carcass that separates from the tread band; the detachable tread is mounted on the deflated carcass, locking into place when the tire is inflated.

Advantages of the detachable-tread tire is that one carcass may be used for many treads; storage space requirements and operating costs should be reduced by just having to replace the tread, as long as the carcass is undamaged.

According to the Army, one carcass should last through four or five treads.

FROM THE SPEAKERS ROSTRUM

Trends in Research and Development at Army Mobility Equipment R&D Center

Address by William B. Taylor, Technical Director, U.S. Army Mobility Equipment Research and Development Center, Ft. Belvoir, Va., to the Graduation Class, Research and Development Management Course, U.S. Army Logistics Management Center, Ft. Lee, Va., Aug. 29, 1969.

This afternoon I had originally planned to regale you with slides and movies in an illustrated talk of some of the weird and wonderful new items of military hardware which are in various stages of development at the U. S. Army Mobility Equipment Research and Development Center (MERDC)*. However, after looking at your agenda for the past two weeks, I [decided] that perhaps you would prefer a more philosophical discussion on some of the lessons we are learning from past problems in testing and fielding new military hardware, and the way in which we are attempting at MERDC to apply results of these lessons to improve our overall "batting average" in getting significant new equipment into the hands of troops.

During the past several years, there have been numerous occasions when items of MERDC equipment, such as engine generators, bridges, construction equipment, air conditioners, POL handling equipment, etc., have failed to pass the stringent gamut of engineer and service tests at the Aberdeen, Ft. Greely, Ft. Knox and Panama test sites of the Army Materiel Command's Test and Evaluation Command (TECOM). These failures range from relatively minor shortcomings relating to a small component, such as a relay or valve (which indicates a need for tighter quality control), to near-catastrophic failures of major subassemblies which clearly indicate that the item should be redesigned.

Regardless of the seriousness of the failure, considerable additional effort is required by the development organization engineers, as well as those of the Army commands who are the users and testers of proposed answers by the developers to the users' stated requirements. Either the failure has to be corrected, or the details of the users' requirements for the item have to be modified to permit the item to be acceptable. In either case, lengthy delays in the fielding of the new equipment invariably result from *any* failure of an item to pass TECOM's testing.

Review of Lessons Learned

At MERDC this past spring, we decided that a critical review of some selected items that had failed engineer/service testing at TECOM was needed to identify "lessons learned" to form a basis for significantly improving our ability to get items through engineer/service testing on time, the first time. I would like to share with you the analysis we did, the results we came up with, and the approach we are taking to apply these results to improve our future performance.

For this analysis, we focused our attention on the universal engineer tractor, probably known to many of you as the UET. Development of the UET began a number of years ago, based on a stated requirement for a quantum jump improvement in combat engineering construction equipment to be used by engineer troops; air-delivered into forward combat zones; and required to move earth, build runways, etc., under a[d]verse conditions of rough terrain, lim[-]ited logistic support, and enem[y] action.

The UET design was completed an[d] prototype models were tested [a]t MERDC, following which enginee[r/] service-test models were procured f[or] TECOM tests against the specified r[e]quirements stated in the Qualitati[ve] Materiel Requirement (QMR). The initial test models fell short of t[he] QMR in a number of areas but, [in] order to expedite the developme[nt] cycle to meet an ENSURE [Exp[e]dited Non-Standard Urgent Requir[e]ment] Southeast Asia requiremen[t] additional models were procur[ed] under advanced production en[g]

**MERDC, located at Ft. Belvoir, Va., is an organizational element of the U.S. Army Mobility Equipment Command, St. Louis, Mo., which is a subordinate command of the Army Materiel Command.*

William B. Taylor was appointed Technical Director of MERDC in 1969. He was formerly scientific advisor for missiles and space in the Office, Chief of Research and Development, Department of the Army. Prior to that he held positions in the manned space flight program of National Aeronautics and Space Administration. He is a graduate of the U.S. Military Academy, West Point, the U.S. Naval Post-Graduate School, and holds a master of science in electronics engineering from The Johns Hopkins University.

neering (APE) funds; some "improvements" were added to the design, and the modified APE models were subjected to further engineer/service testing. The second set of UETs also experienced difficulty, primarily in the areas of reliability and maintainability, and further modifications to the UET were identified as being desirable. Nevertheless, the urgent Southeast Asia requirements for improved earth-moving capabilities in forward areas prompted a plan for limited production of approximately 50 UETs.

Analysis of the several thousand hours of UET prototype test data and of life-cycle cost estimates indicates that the UET can outperform existing inventory dozers, scrapers and dump trucks by factors of 2 or more, and can save from $1 to $2 million per battalion over the 10-year life cycle (primarily because of fewer operators doing the same jobs). However, approval of a limited production buy of UETs has still not been authorized because of the problems identified during engineer/service testing. At the present time, some 10 years after the requirement was established, preparations are being made for a major in-process review soon to determine the future of the UET.

Search for Improved Development Performance

The question we asked ourselves last spring was: How can we improve the performance and shorten the development lead time on an item like the UET, if we were starting today? After going into the details of the design and test history, and comparing both the performance of the various contractors involved, the changes in requirements, and the analysis of previous test data, we concluded that there are three major areas that need concentrated effort by the MERDC developer as well as other members of the Army Materiel Command and the Army Combat Developments Command. These three areas are:

- More realistic requirements (QMRs).
- Improved contracting techniques.
- Improved test plans and procedures.

Let us take these item by item.

More Realistic QMRs.

A fundamental means of avoiding downstream difficulties is to assure at the outset that the users' requirements are both technically attainable and operationally essential in terms of field needs. Obviously, many of the requirements defined before development starts have a degree of uncertainty which must be reduced as development proceeds. Therefore, as the development progresses the requirements should be re-examined when more technical tradeoff data is available. There is a need for a periodic, critical reexamination of the QMR during development of the item, by both the users and developer, recognizing both the technical problems and the costs associated with overcoming them.

These critical reviews require not only the attention of the project engineer in the Army Materiel Command and his counterpart in the Combat Developments Command, but also by the management levels in both agencies. This review should be conducted by civilian engineers to assess the technical and cost achievability of the performance goals, as well as by field grade military officers to assess the essentiality of the qualitative and quantitative requirements for actual field operations. There should be at least two such critical reviews on each QMR: the first prior to formal approval of the QMR by the Department of the Army, and the second after prototype models have been built and tested by the engineers who designed and built them, but before the subsequent models are procured for TECOM's engineer/service testing. This latter review should permit, if necessary, both modification of QMR requirements, based on actual test data, as well as feasible design modifications which could make the engineer/service-test prototypes more responsive to the modified QMR.

Improved Contracting Techniques.

The second lesson learned is that we should improve our contracting provisions for procuring prototype and engineer/service-test models. The normal engineering development cycle calls for contracting for prototype design, fabrication and initial test by the developers (including the contractor) with a subsequent contract (with the same or another contractor) for fabrication of the engineer/service-test models for TECOM tests.

Our objective in improving this arrangement is to place more responsibility on the contractor for the satisfactory performance of test units throughout the period of government testing, including the tests by TECOM which are normally conducted without the contractor's participation. Contracts should clearly state what government tests will be run on the item and that, until the equipment has demonstrated the required performance, the contractor is responsible for the item. In other words, completion of the contract should include satisfactory performance of the item that TECOM tests. In order to do this, we must clearly spell out in the contract the testing we intend to perform, and we must stay within these test parameters if the contractor is to be held responsible. The contract must specify that any failure of the item to meet the performance requirements will require the contractor to modify the item as necessary, at no additional cost to the Government.

In contracting for the TECOM test models, we have the problem of how to require the contractor to build to the drawings resulting from the pre-TECOM development tests and still hold the contractor responsible for meeting the TECOM test requirements. This is a problem since the contractor is normally not involved in the TECOM tests. The problem is compounded if a different contractor is selected from competitive proposals to build the TECOM test models. A feasible approach is to use a form of the new pre-production evaluation (PPE) type contract (now normally used in the first-quantity production contract). Under a PPE contract, the new contractor would be required to make a thorough analysis of the prototype test model drawings, and to recommend any changes he considers necessary for successful achievement of the performance requirements of his contract. After this "open season" on changes (usually a month or two), the contractor is held responsible for producing units which will meet the specified performance requirements. Also, in such contracts, it appears possible to include some form of performance warranty clause under which the contractor agrees to "fix" any item which fails in the TECOM

tests, provided the tests are no more severe than those previously conducted during the developer's prototype tests. This warranty clause should cover the entire period of TECOM tests (often as long as 18 months). Of course, the contractor's price will include some provision for making these fixes but he is motivated to build an item which requires no fixes and, most importantly, he will be required to maintain financial responsibility for the performance of his item during TECOM tests.

Improved Test Plans and Procedures.

The third and possibly the most important lesson learned, which we at MERDC are applying to our current developments based on past problems, has to do with improving our test plans and procedures. Comprehensive and well defined test plans and procedures for prototype testing by MERDC and the contractor are the key to the actions in refining QMRs and in maintaining contractor responsibility through TECOM's tests, which I have just discussed. We will establish and enforce controls to require that total test procedures and plans are reduced to writing by the project engineer, and then approved and periodically reviewed at the intermediate and higher MERDC management levels. TECOM will be included in the development of MERDC test plans and procedures. Test requirements in research and development contract purchase descriptions will define specific tests which will yield quantitative results, suitable for determining the compliance of the contract with each requirement in the QMR.

The results achieved during MERDC prototype tests can then be the basis for revising test procedures to be included in TECOM test plans. We recognize that this more comprehensive and thorough MERDC testing may add to the time required before models are made available to TECOM for final engineer/service testing. However, our experience indicates that in the overall development cycle, a little additional time during MERDC testing can reduce significantly the overall development time, and hasten the day when an item will pass TECOM's tests with flying colors and go into production for use by troops.

To recapitulate, then, we have examined our past experience in getting research development items through TECOM tests and into quantity production. From this experience—some of it quite dismal—we have drawn some lessons learned and are applying them to our current and future efforts in three major areas:

- Initial definition and subsequent refinement, with the Combat Developments Command, of more realistic requirements (QMRs).
- Modified contracting techniques to motivate our industrial partners to retain a sense of responsibility for the performance of the equipment throughout its acceptance testing cycle.
- More thorough and stringent development prototype testing—an abbreviated engineering/service testing, if you will—to permit both refinement of the QMR and modification of engineer/service-test model designs *before* subjecting the item to TECOM test.

I thank you for this opportunity to share with you our lessons learned. I hope they will be of some use to you in achieving our common goal of getting better equipment into the hands of troops sooner.

Unmanned Cargo Planes Planned for Army

Remote controlled, unmanned aircraft for use as combat zone supply transports are being considered by the Army under a proposed requirement for the Transport Assault Supply Transporter (TAST).

As conceived by the Army Combat Developments Command (CDC), Fort Belvoir, Va., TAST will be used to fly into battlefield areas at low altitudes, within the range of small arms fire, with up to 1,000 pounds of cargo. Guided from remote ground stations, TAST will provide supply operations to frontline areas regardless of weather or terrain.

TAST would be used in areas where loss rates for manned aircraft are normally high. Initial plans include TAST platoons for use in direct support of infantry and other combat units, leaving manned aircraft for other missions.

Future roles for TAST could also include wire laying, smoke dispensing, radio communication relay and, if necessary, emergency medical evacuation.

Army Proposes New Artillery

Three new artillery weapons have been proposed by the Army Combat Developments Command (CDC), Fort Belvoir, Va., for use in tactical field support operations.

The first, the aerial artillery weapon, would accomplish the tasks of present aerial rockets and light, close support cannon artillery. In use, the weapon would have both air-to-ground and ground-to-ground capabilities. Combined with single VTOL aircraft transportability, the weapon would reduce the overall number of aircraft required for airmobile support. At present, seperate aircraft are required for rockets and cannon artillery.

The second weapon is the self-propelled armored 155mm howitzer, which would replace the M109 and M109E1 howitzers. As proposed, the new weapon would provide direct support of heavy divisions, specified cavalry regiments, and Corps/Army battalions supporting mechanized and armored units.

The third weapon, the towed 155mm howitzer, would replace the M114A1 howitzer, providing general support and reinforcing fire by field artillery battalions assigned to Corps/Army.

All three proposals are part of the Army 85 program.

AFSC Realigns Conventional Munitions Centers

The Air Force System Command has announced completion of the transfer of engineering and technical personnel from the Air Force Armament Laboratory (AFATL) to the Armament Development and Test Center (ADTC), both located at Eglin AFB, Fla.

The transfer, begun in April 1969, brings into alignment the research development efforts for non-nuclear munitions. ADTC, which has had the managerial responsibility since August 1968, now has under its control the related functions of engineering and acquisition. AFATL will concentrate on its primary mission of research, and exploratory and advanced development.

Centralized Supply Information for DOD, Industry

Captain Ross A. Porter, SC, USN

If the Army has a requirement for aircraft carburetors, a query to the Defense Logistics Services Center (DLSC), Battle Creek, Mich., might reveal that the Marine Corps has carburetors it no longer needs. A defense contractor can also locate excess DOD equipment or parts, needed to perform under his contract, in a similar manner.

The services of DLSC, a field activity of the Defense Supply Agency (DSA), influence industry's relations not only with DOD but other government agencies and with certain foreign governments. Particularly affected are industry organizations concerned with the preparation of bid packages for defense contracts. Other industries, such as those acquiring government-furnished equipment and those buying government surplus, are also directly and indirectly affected by the services provided by DLSC.

Because of the center's services to Federal agencies and, to a progressively greater degree, to government suppliers, defense costs are being reduced significantly. Direct interface with industry is developing as DLSC personnel and computer resources permit.

DLSC's services currently are encompassed in three distinct programs: operational responsibility for the Federal Catalog System, the DOD Materiel Utilization Program, and the DOD Surplus Sales Program.

DLSC has an interest in the characteristics of an item of supply from the time of its design to its disposal from the government inventory.

Until DLSC was established, this data, or intelligence, interface between present DLSC programs was almost nonexistent. The scores of categories of vital logistics item data, assimilated for decades in these programs, are being progressively integrated into one computerized data bank called the Defense Integrated Data System (DIDS) — DLSC's future system. This system will place all data relating to an item of supply (except stock, store and issue information) in a single integrated data bank.

The integrated computer system to be used to support DIDS will probably dwarf, in mass storage capability and random access processing techniques, any known business-oriented system. It will have an initial mass storage capacity of over 13 billion characters, with the capacity to grow to 20 billion. These data will be readily accessible for use not only by DLSC program managers but by logisticians in various assignments, worldwide.

At present it is not envisioned that remote devices will be located at contractor facilities. However, because of the advances of computer hardware technology, and the emphasis on creation of common computer language and universal data nets, it is possible that in the future direct inquiry of DLSC's supply item intelligence might be possible for major contractors.

DLSC services that interest contractors and potential contractors mostly involve the products of the DLSC level of management relative to the Federal Catalog System.

Inherent in this responsibility is assignment of Federal Stock Numbers

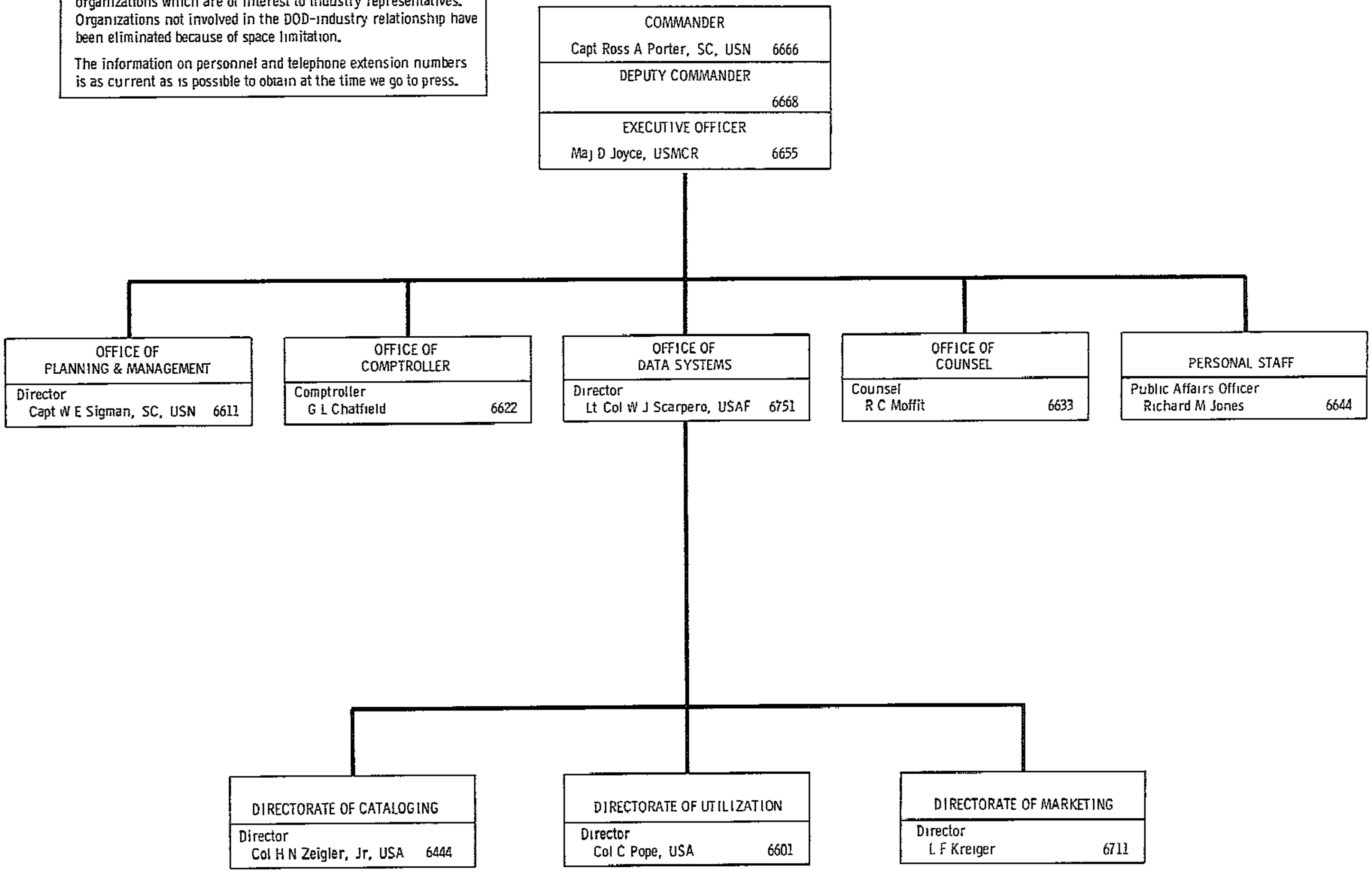
Captain Ross A. Porter, SC, USN, has been Commander of the Defense Logistics Services Center since June 1, 1967. Previously, he served as Supply Officer, San Francisco Bay Naval Shipyard, Vallejo, Calif., and as a member of the staff of the Naval War College. Captain Porter holds a B.S. degree from Northwestern University, and is a graduate of the Advanced Management Program of the Harvard School of Business Administration.

DEFENSE LOGISTICS SERVICES CENTER

Federal Center
Battle Creek, Mich. 49016
Telephone: (616) 962-6511

Editor's Note. Organization charts appearing in the Bulletin are edited by the staff to reflect those elements of the various DOD organizations which are of interest to industry representatives. Organizations not involved in the DOD-industry relationship have been eliminated because of space limitation.

The information on personnel and telephone extension numbers is as current as is possible to obtain at the time we go to press.



(FSNs) for DOD customers, as well as for civil agencies, NATO signatory countries, and for several other foreign governments.

FSNs are assigned to those items which are repetitively procured, stocked, controlled and subjected to central inventory management, reporting, distribution, or redistribution in the supply system of the Army, Navy, Air Force, and Marine Corps, and civil agencies of the Government. The FSN is a common means of retrieving data from DLSC records.

Process of Provisioning Screening

DLSC becomes involved with an item of supply during the weapon system provisioning process by furnishing an item intelligence service that determines the need for FSN assignment. This involvement in the provisioning aspect of logistics provides, early in the procurement process, item identification and other vital supply management data.

An industry benefit of provisioning screening is that it does not burden suppliers with production of technical documentation that might already be in DLSC files. Data is provided that enhances the transfer of excess property, thus preventing the purchase of unnecessary spare parts. It also helps expand the procurement base.

To accomplish provisioning screening, the industry contractor or government procuring activities submit data, consisting of the manufacturers' codes and part numbers, to determine if the item has been assigned an FSN and is already recorded as an active item in the U.S. Government upply system. Computers are used to ompare input data with the data on le.

During FY 1968 approximately 6 illion provisioning queries were proessed by DLSC. Over 40 percent of he queries disclosed availability of duplicate items.

Also of interest to industry is the Federal Supply Code for Manufacturers (FSCM) assigned and maintained at DLSC. We assign five-digit lentifying numbers to manufacturers 10 qualify as sources of supply. Curntly the FSCM files list 58,000 ms.

Two methods are used to compare ms suggested for entry into the supply system with the current catalog data. They are the reference method and the descriptive method. Both are designed to minimize the entry of *new items* into the system by identifying duplicate items.

The reference method is accomplished by screening manufacturers' codes and manufacturers' part numbers against the existing part number file of 9 million part numbers. A little over half of the 4.5 million items in the Federal Catalog System, with a registered government customer interest, are identified through a comparison process in this manner.

The descriptive method, which is the preferred and the most effective method of item entry control, requires submission of item identification characteristics data in a uniform, computer processable mode. The method significantly enhances our ability to delineate like items by visual or machine comparison of characteristics.

The latter is accomplished by using Descriptive Patterns (DPs) and/or the new Federal Item Identification Guides (FIIGS). Both provide guides that aid in the preparation of item characteristic submission in a machine processable mode.

There is a concentrated effort to have as many items as possible in the Federal supply system cataloged in the descriptive mode. The entry of as many items into the Federal Catalog System in the description mode, and the conversion of items already in the system to this mode, will also exploit the capability of our upcoming DIDS computer system with its gigantic data bank.

Master Cross Reference List

Early last year DLSC compiled, printed and distributed to the four Military Services a Master Cross Reference List (MCRL). The MCRL references over 9 million industry part numbers to FSNs. It contains the FSCM and the applicable FSN related to part number(s).

The consolidated MCRL, containing items used by all the Military Services, is available to industry and other interested organizations for $200 a year from the U.S. Government Printing Office, Sales Planning Section, P.O. Box 1533, Washington, D.C. 20013. This annual subscription cost includes supplements. Initially, the sheer size of the 65-volume appears frightening. It is indexed, however, to speed identification of part numbers. It is a valuable aid in identifying the relationships of part numbers to FSNs. The cogizant military procurement office will help establish FSN-manufacturers part number relationships for contractors performing under contracts which include provisioning screening procedures.

There are many Federal cataloging publications that can also help contractors fulfill government cataloging obligations. These publications can also be purchased from the Superintendent of Documents, U.S. Government Printing Office. An index of these publications, containing a synopses of each publication, will be furnished by DLSC upon request.

In natural sequence of the government's logistic cycle, DLSC operates the DOD materiel utilization program. The primary purpose of this program is to satisfy the needs of any one Military Service by redistributing materiel which may be excess to other Military Services. To the extent possible, computer programs at DLSC use the Federal Item Identification Number (FIIN), a portion of the FSN, to match requirements to excess assets.

Last year nearly $1 billion worth of materiel was referred to Federal agencies who indicated a need for specific excess items. Hundreds of millions of dollars worth of materiel referred was accepted.

To a progressively greater degree DOD contractors are also availing themselves of this source to obtain equipment needed to fulfill government contracts.

The primary communication media used to apprise contractors of available materiel are direct mail in the form of printed excess listings, flyers and brochures. Last year, through these media, one government contractor was able to locate excess DOD equipment valued at over $800,000 needed by his firm to perform under his contract. Acquisition of government furnished equipment supplements tight budgets, speeds fulfilling contracts by reducing lead time, and also saves tax dollars.

To benefit from this source of equipment, write to the Director of Utilization, Defense Logistics Services Center, Federal Building

(Continued Inside Back Cover)

Top 100 Defense Contractors Announced

Top 100 Companies and Their Subsidiary Corporations Listed According to Net Value of Military Prime Contract Awards Fiscal Year 1969 (July 1, 1968—June 30, 1969)

Corporate acquisitions and mergers in FY 1969 continued to affect the makeup of the DOD list of 100 companies which, together with their subsidiaries, were awarded the largest dollar volume of military prime contract of $10,000 or more. These 100 companies accounted for $25.2 billion, or 3.8 percent less than in FY 1968, while total awards to all U.S. companies were down by 5 percent to $36.9 billion. The top 100 companies received 68.2 percent of the FY 1969 total compared with 67.4 percent in the previous year. Contributing to the higher percentage awarded the top 100 was not only corporate restructuring, but also increases in the procurement of ammunition and of missile and space systems, highly concentrated industries, while concurrent decreases were being experienced in the procurement of clothing and textiles and other commercial type items.

The following list shows that the first five companies received 18.9 percent of the total received by all U.S. companies in FY 1969. This was lower by 1.7 percentage points than was recorded by FY 1968; however, the percentage for the next 20 companies totaled 25.9 percent or almost 1 percent more than in FY 1968. The largest company in FY 1969 received awards aggregating $2,040 million, compared with $2,239 million for the largest in FY 1968. To be included in the list in FY 1969 required $48 million in awards, against $50 million in FY 1968.

The FY 1969 list of the top 100 companies shows 12 companies which did not appear on the list for FY 1968. Of these 2 appear between positions 51 and 74, and the remaining 10 between positions 76 and 100.

Companies listed in FY 1969 but not in FY 1968 are:

Aluminum Company of America
Atlantic Richfield Co.
Dynalectron Corp.
Firestone Tire & Rubber Co.
Flying Tiger Line, Inc.
Kidde (Walter) & Co., Inc.
Le Tourneau, R. G., Inc.
National Gypsum Co.
Southern Airways, Inc.
Talley Industries, Inc.
Tumpane Co.
Whittaker Corp.

Compaines listed in FY 1968 but not in FY 1969 are:

Aerodex, Inc.
Atlas Chemical Industries, Inc.
Automatic Sprinkler Corporation of America
Condec Corp.
Emerson Electric Co.
International Harvester Co.
Johns Hopkins University (N)
Lykes Corp.
Mason & Hanger Silas Mason Co.
Susquehanna Corp.
Vinnell Corp.

Of the 88 companies appearing in both the FY 1968 and FY 1969 lists, 49 bettered their position, 33 were in a lower position and 6 showed no change. Companies are considered as appearing on the list in both years despite mergers and name changes if a major component of a newly constituted company made the list in both years.

Listing of the top 100 companies and their subsidiaries, in order of rank, is given below. The report is compiled by the Directorate for Information Services, Office of the Assistant Secretary of Defense (Comptroller), Washington, D. C. 20301.

RANK	COMPANIES	THOUSANDS OF DOLLARS
	U.S. TOTAL [a]	$36,888,601
	Total, 100 Companies and Their Subsidiaries [b]	26,176,240
1.	Lockheed Aircraft Corp	2,004,423
	Lockheed Shipbuilding Construction	35,752
	Ventura Mfg Co.	61
	TOTAL	2,040,236
2	General Electric Co	1,619,095
	General Electric Supply Co	1,680
	TOTAL	1,620,775
3.	General Dynamics Corp.	1,228,903
	Dynatronics, Inc.	448
	Stromberg Carlson Corp.	10,680
	Stromberg Datagraphics, Inc	2,879
	United Electric Coal Co.	145
	TOTAL	1,243,055
4.	McDonnell Douglas Corp	1,031,752
	Advanced Communications, Inc	524
	Conductron Corp	32,021
	Hycon Mfg Co	4,862
	Tridea Electronics, Inc	584
	TOTAL	1,069,743
5.	United Aircraft Corp	997,380
6.	American Telephone & Telegraph Co	152,349
	Chesapeake & Potomac Telephone Co	13,939
	Illinois Bell Tel Co	217
	Mountain States Tel & Tel Co	1,688
	New England Tel & Tel Co	564
	New Jersey Bell Telephone Co	578
	New York Telephone Co	52
	Northwestern Bell Telephone Co	236
	Ohio Bell Telephone Co	270
	Pacific Northwest Bell Telephone Co	145
	Pacific Telephone & Telegraph Co	172
	Southern Bell Telephone & Telegraph Co	2,325
	Southwestern Bell Telephone Co	1,729
	Teletype Corp	16,926
	Western Electric Co, Inc	723,389
	TOTAL	914,579
7.	Ling Temco Vought, Inc	26,554
	Altec Service Co	32
	Braniff Airways, Inc	43,327
	Computer Technology, Inc	54
	Continental Electronics Mfg Co	8,895
	Jefferson Wire & Cable Corp	138
	Jones & Laughlin Steel Corp	2,803
	Kentron Hawaii, Ltd	15,448
	L T V Electrosystems	182,160
	L T V Aerospace Corp	617,706
	L T V Ling Altec, Inc	770
	Okonite Co The	997
	Service Technology Corp	10,645
	Staco, Inc	11
	Tamar Electronics Industries, Inc	125
	Wilson & Co, Inc	9,154
	Wilson Sporting Goods Co	295
	TOTAL	914,114

8.	North American Rockwell Corp	673,840
	Morse Controls, Inc	201
	Remmert-Werner, Inc	134
	TOTAL	674,175
9.	Boeing Co	653,638
10.	General Motors Corp	581,407
	Frigidaire Sales Corp	32
	TOTAL	584,439
11.	Raytheon Co	542,817
	Edex Corp	15
	Heath DC & Co	25
	Machlett Laboratories, Inc	3,470
	Micro State Electronics Corp	102
	Raytheon Education Co	73
	Seismograph Service Corp	270
	TOTAL	546,772
12.	Sperry Rand Corp	467,861
13.	Avco Corp	456,054
14.	Hughes Aircraft Co	438,756
	Meva Corp	260
	TOTAL	439,016
15.	Westinghouse Electric Corp	424,175
	Electro Insulation, Inc	15
	K-W Battery Co	197
	Sanford Marine Services, Inc.	67
	Thermo King Corp	294
	Thermo King Sales & Service.	12
	Urban Systems Dev Corp	2,911
	Westinghouse Electric Intl, SA	278
	Westinghouse Electric Supply Co	886
	Westinghouse Learning Corp	723
	TOTAL	429,558
16.	Textron, Inc	13,776
	Accessory Products Co	29
	Aetna Bearing Co, Inc	34
	Bell Aerospace Corp	412,700
	Camcar Screw & Mfg Co	140
	Fafnir Bearing Co	542
	Textron Electronics, Inc	606
	Townsend Co	435
	Walker-Parkersburg	17
	Waterbury Farrel	11
	TOTAL	428,290
17.	Grumman Aircraft Engineering Corp.	417,052
18.	Honeywell, Inc	405,575
19.	Ford Motor Co	67,202
	Philco Ford Corp	329,131
	TOTAL	396,333
20.	Olin Matheison Chemical Corp	354,359
21.	Litton Industries, Inc	14,586
	Aero Service Corp	200
	Allis (Louis) Co	220
	American Book Co	24
	Bionetics Research Laboratories	213
	Clifton Precision Products Co	11
	Ingalls Shipbuilding Corp	1,052
	Kimball Systems, Inc	27
	Litton Precision Prods, Inc	8,524
	Litton Systems, Inc	291,890
	Monroe International, Inc	127
	New Britain Machine Co	208
	Streater Industries, Inc	20
	TOTAL	317,102
22.	Teledyne, Inc	62,559
	Adcon, Inc	277
	Amelco, Inc	3,816
	Brown Engineering Co, Inc	3,256
	Columbia Steel & Shafting Co	39
	Columbia-Summerill Corp	27
	Continental Aviation & Engr Corp	38,116
	Continental Device Corp	56
	Continental Motors Corp	64,897
	Electro Development Co	33
	Geotechnical Corp	93
	Getz William Corp	105
	Gill Electric Mfg Corp	755
	Gurley (W&LE)	308
	H & H Engineering Co	20
	Hydra Power Corp	289
	Isotopes, Inc	1,103
	Kinetics Corp	122
	King Metal Products, Ltd	24
	McKay Co	63
	Micronetics, Inc	70
	Milliken D B Co, Inc	217
	Monarch Rubber Co	74
	Ordnance Specialties, Inc	135
	Packard Bell Electronics Corp	5,906
	Pines Engineering Co, Inc	14
	Republic Mfg Co	119
	Ryan Aeronautical Corp	121,233
	Techdata, Ltd	37
	Thermatics, Inc	13
	Wah Chang Corp	55
	Wisconsin Motor Corp	1,698
	TOTAL	308,455
23.	R C A Corp	298,868
	National Broadcasting Co, Inc	13
	RCA Defense Electronics Corp	91
	RCA Institutes, Inc	20
	TOTAL	298,992
24.	Standard Oil Co (New Jersey)	
	American Cryogenics Inc	85
	Enjay Chemical Co	216
	ESSO A G	1,302
	ESSO International Corp	151,098
	ESSO Petrol Co, Ltd	66
	ESSO Research & Engineering Co	885
	ESSO Standard Eastern, Inc	224
	ESSO Standard Italiana	2,463
	ESSO Standard Oil Co S A	5,001
	ESSO Standard Thailand, Ltd	78
	Humble Oil & Refining Co	129,635
	TOTAL	291,053
25.	Martin Marietta Corp	264,279
26.	General Tire & Rubber Co	8,307
	Aerojet Delft Corp	272
	Aerojet General Corp	212,924
	Batesville Mfg Co	41,154
	Frontier Airlines, Inc	45
	General Tire International Co	799
	TOTAL	263,501
27.	Intl Business Machines Corp	256,304
	Science Research Associates, Inc	177
	Service Bureau Corp	142
	TOTAL	256,623
28.	Raymond Morrison Knudsen (JV)	254,000
29.	International Telephone & Tel Corp	120,206
	Barton Instrument Corp	27
	Bobbs-Merrill Co, Inc	11
	ITT Continental Baking Co	1,746
	E T C, Inc	79
	Federal Electric Corp	66,088
	ITT Electro Physics Laboratories	3,014
	ITT Gilfillan, Inc	38,643
	ITT Hammel Dahl	11
	ITT Technical Services, Inc	8,392
	Jennings Radio Mfg Corp	20
	TOTAL	238,267
30	Tenneco, Inc	
	Davis Mfg, Inc	203
	Gas Equipment Engrs, Inc	15
	Newport News Shipbld & Dry Dock Co	236,021
	Tenneco Chemicals, Inc	467
	TOTAL	236,679
31.	Dupont E I De Nemours & Co	41,582
	Remington Arms Co	170,383
	TOTAL	211,965
32.	F M C Corp	189,639
	Gunderson Bros Engineering Corp	3,807
	Kilby Steel Co, Inc	2,179
	TOTAL	195,625
33.	Norris Industries	187,553
34.	Bendix Corp	177,806
	Bendix Field Engineering Corp	5,923
	Bendix Westinghouse Automotive	129
	Fram Corp	433
	Marine Advisers, Inc	31
	P & D Mfg Co Inc	78
	Scott Testers, Inc	37
	TOTAL	184,437
35.	Hercules, Inc	179,364
	Haveg Industries, Inc	258
	TOTAL	179,622
36.	Northrop Corp	106,992
	Hallicrafters Co	32,468
	Northrop Carolina, Inc	4,874
	Page Communications Engineers, Inc	34,311
	Warnecke Electron Tubes, Inc	262
	TOTAL	178,907
37.	Uniroyal, Inc	174,061
	Uniroyal International Corp	27
	TOTAL	174,088
38.	T R W, Inc	169,487
	Crescent Insul Wire & Cable Co, Inc	73
	Globe Industries, Inc	316
	Gregory Industries, Inc	12
	International Controls Corp	380

Ramsey Corp	33
T R W Semiconductors, Inc	29
United-Carr, Inc	49
TOTAL	170,379
39. Pan American World Airways, Inc	167,437
40. Asiatic Petroleum Corp	155,583
41. Mobil Oil Corp	151,479
Mobil Chemical Co	12
Mobil Oil New Zealand, Ltd	24
TOTAL	151,515
42. Standard Oil Co of Calif	73,406
Caltex Asia, Ltd °	2,866
Caltex Australia °	13
Caltex Oil Products Co °	61,280
Caltex Oil Thailand, Ltd °	2,058
Caltex Oversea, Ltd °	311
Caltex Phillippines, Inc °	70
Chevron Asphalt Co	33
Chevron Chemical Co	552
Chevron Oil Co	8,323
Chevron Oil Trading Co	273
Chevron Shipping Co	192
Standard Oil Co Kentucky	4,396
TOTAL	148,773
43. Fairchild Hiller Corp	148,549
Burns Aero Seat Co, Inc	37
TOTAL	148,586
44. Collins Radio Co	145,751
45. Kaiser Industries Corp	495
Hydromar Corp	173
Kaiser Aerospace & Electronics Co	2,936
Kaiser Jeep Corp	118,517
Kaiser Steel Corp	11,095
National Steel & Shipbuilding Co	9,182
TOTAL	142,398
46. General Telephone & Electn Corp	25
Automatic Electric Co	9,029
Automatic Electric Sales Corp	200
Fleetwood Corp	15
General Telephone & Electronic Lab	268
General Telephone Co Southeast	52
General Telephone Directory Co	58
Hawaiian Telephone Co	8,026
Lenkurt Electric Co, Inc	9,556
Sylvania Electric Products, Inc	113,247
TOTAL	140,470
47. Day & Zimmerman, Inc	137,793
48. Texas Instruments, Inc	132,483
49. Federal Cartridge Corp	131,901
50. Magnavox Co	126,245
General Atronics Corp	4,003
Selmer (H & A), Inc	12
Sentinel, Inc	22
TOTAL	130,282
51. Thiokol Chemical Corp	127,901
Delta Corp	65
Uniplex, Inc	104
TOTAL	128,070
52 Texaco, Inc	22,966
Caltex Asia, Ltd °	2,866
Caltex Australia °	12
Caltex Oil Products Co °	61,279
Caltex Oil Thailand, Ltd °	2,057
Caltex Overseas, Ltd °	310
Caltex Phillippines, Inc °	70
Jefferson Chemical Co, Inc	695
Texaco Export, Inc	30,305
Texaco Puerto Rico, Inc	2,855
Texaco Trinidad, Inc	17
White Fuel Co, Inc	541
TOTAL	123,973
53. Chrysler Corp	117,688
Chrysler Outboard Corp	4,128
TOTAL	121,816
54. Pacific Architects & Engineers, Inc	120,959
55. Sanders Associates, Inc	117,707
Mithras, Inc	775
TOTAL	118,482
56. United States Steel Corp	109,720
Reactive Metals, Inc	291
US Steel International, Inc	7,787
TOTAL	117,798
57. Goodyear Tire & Rubber Co	57,878
Goodyear Aerospace Corp	56,484
Motor Wheel Corp	2,098
TOTAL	116,460
58. Singer Co	1,301
Controls Co of America	439
EMC Instrumentation, Inc	73
Friden, Inc	1,906
General Precision Equipment Corp	40
Graflex, Inc	1,060
HRB-Singer, Inc	7,749
National Theatre Supply Co	29
Singer General Precision, Inc.	91,822
Singer Sewing Machine Co	112
Strong Electric Corp	644
Tele-Signal Corp	9,099
Vapor Corp	1,968
TOTAL	116,242
59. Chamberlain Mfg Corp	115,925
60. Lear Siegler, Inc	83,650
American Avitron	443
Astek Instrument Corp	11
L S I Service Corp	31,247
Lighting Products, Inc	33
National Broach & Machine Co	11
Transport Dynamics, Inc	358
TOTAL	115,758
61. American Machine & Foundry Co	115,026
AMF Beaird, Inc	27
AMF Tuboscope, Inc	82
Cuno Engineering Corp	91
Harley-Davidson Motor Co	41
TOTAL	115,266
62. Colt Industries, Inc	7,866
Chandler Evans, Inc	9,273
Colts, Inc	84,792
Crucible Steel Corp	158
Elox Corp	89
Fairbanks Morse, Inc	5,696
Holley Carburetor Co	4,244
Pratt & Whitney, Inc	2,407
TOTAL	114,425
63. Eastman Kodak Co	108,998
Eastman Chemical Products Corp	48
Eastman Kodak Stores, Inc	764
Kodak Export, Ltd	38
TOTAL	109,848
64. City Investing Co	
American Electric Co	43,818
Hayes Holding Co	50,431
Moe (A E) & Co, Inc	15
Rheem Mfg Co	247
Wells Marine, Inc	14,613
Wilson Shipyard, Inc	75
TOTAL	109,199
65. Whittaker Corp	60,195
Aircraft Hydro-Forming, Inc.	345
American Finishing Co	159
Berwick Forge & Fabricating Corp	174
Columbus Milpar & Mfg Co	27,224
Detroit Bolt & Nut Co	85
General Aerospace Materials Corp	412
Hol-Gar Mfg Corp	3,438
Jenks Metals Co	880
May Aluminum, Inc	402
Nautec Corp	66
Precision Forge Co	980
Space Sciences, Inc	266
Straightline Mfg Co	13,112
TOTAL	107,638
66. American Mfg Co of Texas	106,745
67. Massachusetts Institutechnology	100,519
68. Gulf Oil Corp	86,443
Gulf General Atomic, Inc	5,883
Gulf Oil Trading Co	2,988
Industrial Asphalt, Inc	298
Pittsburg Midway Coal Mining Co	330
TOTAL	95,942
69. National Presto Industries, Inc	94,908
70. Kidde Walter & Co, Inc	10,632
American Desk Mfg Co	72
Associated Testing Labs, Inc	51
Audio Equipment Co, Inc	565
Carpenter Mfg Co	56
Chatos Glass Co	55
Columbian Bronze Corp	246
Craig Systems Corp	2,111
Crane Hoist Engr Corp	185
Dura Corp	116
Fenwal, Inc	840
Grove Mfg Co	845
Harrington & Richardson, Inc	25,767
United States Lines Co	50,380
TOTAL	91,921
71. Signal Companies, Inc (The)	29
Allison Steel Mfg Co	85
Dunham Bush, Inc	501
Garrett Corp	72,698
Mack Trucks, Inc	11,404
Signal Oil & Gas Co	5,606
Southland Oil Corp	942
TOTAL	91,265

72.	Curtiss Wright Corp	90,680
	Dorr-Oliver Corp	28
	Marquette Metal Products Co	213
	Metal Improvement Co	90
	Zarkin Machine Co	160
	TOTAL	91,171
73.	Harvey Aluminum Inc	21,606
	Harvey Aluminum Sales	68,852
	TOTAL	90,458
74	States Marine Lines, Inc	87,059
75.	Reynolds (RJ) Industries, Inc	18,474
	Equipment, Inc	3,346
	Gulf Puerto Rico Lines, Inc	384
	Reynolds (RJ) Foods, Inc	456
	Sea-Land Service, Inc	62,269
	TOTAL	84,929
76.	Aerospace Corp	76,246
77.	Motorola Inc	73,061
	Motorola Overseas Corp	103
	TOTAL	73,164
78.	Automation Industries, Inc	1,617
	Consolidated American Services, Inc	550
	Facilities Mgmt Corp	4,986
	Spartan Aviation, Inc	3,157
	Vitro Corp of America	62,802
	TOTAL	73,112
79.	Talley Industries, Inc	21,273
	Braincon Corp	32
	General Time Corp	50,665
	Lakeville Precision Molding, Inc	38
	Waterbury Button Co	77
	Waterbury Companies, Inc	385
	TOTAL	72,470
80.	Harris-Intertype Corp	1,159
	Gates Radio Co	371
	PRD Electronics, Inc	39,393
	R F Communications, Inc	3,616
	Radiation, Inc	27,167
	TOTAL	71,606
81.	Firestone Tire & Rubber Co	66,640
	Hamill Mfg Co	16
	TOTAL	66,656
82.	Seatrain Lines, Inc	41,906
	Commodity Chartering Corp	3,169
	Hudson Waterways Corp	15,822
	Transeastern Shipping Corp	3,675
	TOTAL	64,572
	Aluminum Company of America	64,331
	Rea Magnet Wire Co, Inc	109
	Wear Ever Aluminum, Inc	18
	TOTAL	64,458
4.	Hughes Tool Co	63,693
35.	National Gypsum Co	63,214
86.	Hazeltine Corporation	60,472
	Wheeler Laboratories, Inc	81
	TOTAL	60,553
	'estern Union Telegraph Co	57,686
	ontrol Data Corp	50,757
	Associated Aero Science Labs, Inc	1,352
	C E I R, Inc	541
	Electronic Accounting Card Corp	894
	Pacific Technical Analysts, Inc	3,293
	T R G, Inc	76
	TOTAL	56,913
89.	White Motor Corp	25,056
	Hercules Engines, Inc	30,751
	Minneapolis Moline, Inc	465
	Oliver Corp	12
	TOTAL	56,284
90.	Continental Air Lines, Inc	55,242
91.	World Airways, Inc	54,930
92.	Atlantic Richfield Co	31,347
	Sinclair Koppers Co	13
	Sinclair Oil Corp	8,387
	Sinclair Refining Co	14,590
	TOTAL	54,311
93.	Tumpane Co, Inc	53,963
94.	Cessna Aircraft Co	52,685
	Aircraft Radio Corp	732
	TOTAL	53,417
95.	Smith Investment Co	
	Smith A O Corp	51,567
	Smith A O of Texas	134
	TOTAL	51,701
96.	Sverdrup & Parcel & Assocs, Inc	430
	ARO, Inc	49,817
	TOTAL	50,247
97.	Dynalectron Corp	50,049
98.	Letourneau R G, Inc	49,903
99.	Flying Tiger Line, Inc	48,261
100.	Southern Airways, Inc	48,260

FOOTNOTES

[a] Net value of new procurement actions minus cancellations, termination and other credit transactions. The data include debit and credit procurement actions of $10,000 or more, under military supply, service and construction contracts for work in the United States plus awards to listed companies and other U.S. companies for work overseas.

Procurement actions include definitive contracts, the obligated portions of letter contracts, purchase orders, job orders, task orders, delivery orders, and any other orders against existing contracts. The data do not include that part of indefinite quantity contracts that have not been translated into specific orders on business firms, nor do they include purchase commitments or pending cancellations that have not yet become mutually binding agreements between the Government and the company.

[b] The assignment of subsidiaries to parent companies is based on stock ownership of 50 percent or more by the parent company, as indicated by data published in standard industrial reference sources. The company totals do not include contracts made by other U.S. Government agencies and financed with Defense Department funds, or contracts awarded in foreign nations through their respective governments The company names and corporate structures are those in effect as of June 30, 1969, and for purposes of this report company names have been retained unless specific knowledge was available that a company had been merged into the parent or absorbed as a division with loss of company identity. Only those subsidiaries are shown for which procurement actions have been reported.

[c] Stock ownership is equally divided between Standard Oil Co of California and Texaco, Inc; half of the total of military awards is shown under each of the parent companies

(N)—Non-profit

(JV)—Joint venture of Raymond International, Inc, Morrison-Knudsen Co, Inc, Brown & Root, Inc; and J. A. Jones Construction Co.

Lumber Procurement Management Realigned

Management and technical guidance of Armed Forces lumber procurement, a responsibility of the Defense Supply Agency (DSA), will be consolidated at the Portland, Ore., Wood Products Office, Defense Construction Supply Center. To be effective April 1, 1970, the consolidation will not alter procurement methods or lessen opportunities for suppliers, the DSA announcement said.

Lumber procurement functions are being realigned to reflect current procurement patterns, and to achieve more efficiency and economy of operation. About two-thirds of military softwood procurements are awarded to western suppliers. The relatively small hardwood requirements are supplied from the southeastern United States.

Currently lumber is procured by two offices, the Portland office and the Atlanta, Ga., Wood Products Purchasing Office.

In addition to being the principal procurement office, the Portland Wood Products Office will issue all written solicitations and will perform procurement support functions. The Atlanta office will receive solicitations for East Coast purchases for bid opening, abstracting and award. The Atlanta office also will make emergency buys from East Coast suppliers and act as DSA liaison in lumber matters.

Cold Region Lab Goes to Engineers

Command authority of the U.S. Army Terrestrial Sciences Center, Hanover, N.H., with the exception of the Photographic Interpretation Research Division, has been transferred from the Army Materiel Command to the Office of the Chief of Engineers.

Redesignated the Army Cold Regions Research and Engineering Laboratory, the center's mission was not changed.

Meeting Today's Logistical Challenge

The Army Materiel Command (AMC) has the herculean task of providing the U.S. Army modern weapons and equipment necessary for survival in combat operations.

This mission involves research and development, procurement and production, and supply and maintenance in the field. Today, thousands of scientists, engineers, and technicians are engaged in research and development activities conducted within the laboratories, arsenals, and testing installations of the command. Several thousands more are employed in activities within industry, higher educational institutions, and non-profit research foundations having Army contracts or grants.

Budget and expenditures of the command have averaged approximately $15 billion each fiscal year since FY 1966. Budget programs scheduled for FY 1970 are:

- $8.3 billion for PEMA (Procurement of Equipment and Missiles, Army).
- $1.7 billion, Stock Fund.
- $1.7 billion, OMA (Operation and Maintenance, Army).
- $1.1 billion, RDT&E (Research, Development, Test and Evaluation).

AMC headquarters at Gravelly Point, Va., adjacent to Washington National Airport, provides the policy direction for the command's farflung operations. Nine major subordinate commands, located throughout the eastern half of the United States, serve as the "mid-management" level. There are seven commodity commands responsible for integrated commodity management of assigned categories of weapons, equipment and supplies; one test and evaluation command; and one logistics support command.

The actual execution of the Army's materiel program is accomplished by AMC's individual installations and activities, some reporting directly to the headquarters and others to major subordinate commands. They range from depots, laboratories, arsenals, schools, maintenance shops, test ranges, proving grounds, and procurement offices in the United States to customer assistance offices and logistics management offices throughout Europe and the Far East. There are 80 military installations and 100 activities in the AMC network.

The command is responsible for a materiel inventory of approximately $21 billion, of which 50 percent is in depots or in transit and 50 percent is in the hands of troops The magnitude of AMC's operation is illustrated by Army-sponsored cargo movements—surface and air—from the United States to Vietnam: around 7 million tons each fiscal year since July 1966. Last year AMC took more than 800,000 procurement actions which had a total value of slightly less than $9.5 billion.

Organization and Mission

AMC was activated Aug. 1, 1962, as a part of the overall reorganization of the Army. This reorganization realigned the responsibilities of the Army General Staff. In addition, various operational responsibilities, previously carried out by the General Staff, were transferred to Army field commands, leaving the General Staff free to concentrate on planning.

The materiel functions of six of the Army's then seven technical services (Quartermaster, Ordnance, Chemical, Signal, Engineers, and Transportation) and many logistical functions of

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the General Staff were assigned to AMC. The Medical Corps was the only one of the seven technical services to retain its supply mission.

Before the Army's reorganization, each technical service was responsible for its personnel, doctrine, materiel and training. Now these responsibilities have been functionalized.

AMC has four basic missions:

• Performance of assigned materiel functions of the Department of the Army. These functions encompass research and development, product engineering, test and evaluation, procurement and production, inventory management, and maintenance. In addition, the command operates the continental U.S. wholesale supply and maintenance system which consists of storage and distribution, transportation, maintenance, and disposal of materiel.

• Provision of materiel and related service support to U.S. forces engaged in contingency operations, and support of foreign customers under the various international logistics agreements.

• Provision of worldwide technical and professional guidance and assistance to customers. This may involve sending a team to a command or foreign country to assist in deprocessing or in training recipients of new materiel; or sending special teams to assist customers in resolving maintenance, storage and distribution problems.

• Direction of assigned subordinate commands, installations and activities.

In June 1969, the organization of AMC headquarters was realigned to provide better control over assigned missions and functions, to reduce the span of control, and to achieve greater use of managerial talent.

Under the realigned AMC organization, its commander's span of control was reduced through the use of deputies with specific roles in specific areas. AMC now provides command and control over each of four major segments of operations: the laboratories, focusing on the scientific community; materiel acquisition, focusing on the industrial base; logistics support for the Army in the field; and management of resources, people, money and facilities.

The principal deputy serves as the ommanding general's alter ego and resources manager. He directs the activities of the comptroller, the director of personnel and training, and the director of installations and services.

New to the headquarters are two additional deputies—a deputy commanding general for materiel acquisition and a deputy commanding general for logistical support. The deputy for materiel acquisition centers his attention on the industrial base, with control of research and engineering, procurement and production, and material requirements. He also controls the U.S. Army Major Items Data Agency (USAMIDA), located at Letterkenny Army Depot, Chambersburg, Pa.

The deputy commanding general for logistics support is responsible for all aspects of customer service with the primary responsibility of responding to the needs of the command's worldwide requirements. He commands the 19 AMC depots.

The responsibilities of the deputy for laboratories were not affected by the reorganization. He continues to focus his interest on the scientific community and to direct the activities of the AMC in-house laboratories.

The positions of director of quality assurance and director for management information systems have been elevated. The latter, in his expanded role, is accelerating the development of automated management systems. He is expected to provide the command with key indicators and trends needed for sound management.

Also, under the realignment, the number of project managers has been reduced from 67 to 45 by assigning 12 projects to major subordinate commanders and by combining 10 projects with other project manager offices.

The span of control has been reduced about 60 percent through these actions. Instead of 190 commands, agencies and individuals reporting directly to the command group, there are now less than 80.

The headquarters operates with a staff of approximately 2,300 personnel, 360 military and 1,940 civilians. The coordinating staff consists of six major directorates: Maintenance; Materiel Requirements; International Logistics; Procurement and Production; Distribution and Transportation; and Research, Development and Engineering. Each has full responsibility for accomplishment of those AMC missions within its functional area. Five other major directorates—Comptroller and Director of Programs, Installations and Services, Personnel and Training, Quality Assurance, and Management Systems and Data Automation—perform coordinating and support functions.

Special staff elements include those normal to any major command headquarters, plus specific offices responsible for Operational Readiness, Logistics Data Management, and Combat Surveillance and Target Acquisition which perform functions unique to the materiel mission. Additionally, special assistants advise the commanding general in such specialized areas as science, engineering, labor relations and equal employment.

The headquarters also includes about a dozen project/product managers, together with staff officers representing the rest of the project/product managers located elsewhere in the command.

Also located at the headquarters, liaison officers represent various other U.S. military elements and those of Great Britain, Canada, and the Federal Republic of Germany.

Requirements and Procurement

Determination of materiel requirements is a complex procedure within AMC. Consideration must be given to authorized strength by component, war reserve requirements, estimation of consumption, and an estimation of assets in hand. Many of the basic item requirements are computed on an individual basis, using the factors of initial issue, replacement, pipeline, special operational projects and maintenance float. Initial issues are determined from tables indicating the number of items, by troop unit, which are authorized. The total is weighed against the DOD-approved Army force. Replacement encompasses a percentage of the initial allowance which is worn out or consumed. Projection of these data present management problems, particularly because peacetime and wartime replacement and consumption factors vary.

The pipeline is another computation factor which is based on intransit time and which varies by geographic area and by mode of transportation. Operational projects are determined

on the basis of the mission to be performed, are approved by the Department of the Army, and are indicated in a complete bill of materials.

The sum total of initial issue, replacement, pipeline, maintenance float and operational projects constitute the gross Army requirement for an item.

AMC is responsible for approximately 75 percent of the Army's total annual procurement dollars placed under contract. In addition, under the single department procurement policy of the Defense Department, AMC procures many items of ammunition, weapons and vehicles for all the Military Services. Seven of the nine major subordinate commands operate as buying centers, with each specializing in their particular commodity. The name of each command (Weapons, Missile, Tank-Automotive, Electronics, Munitions, Aviation Systems, and Mobility Equipment) indicates the commodity and related research and development with which each is concerned. These commands also give functional procurement support to project managers responsible for vertical management of major weapons acquisition.

Subordinate Commands

AMC's nine major subordinate commands make the complex operation work. Each is important to the overall program. The subordinate commands and their responsibilities are:

Army Electronics Command, Ft. Monmouth, N.J., (plus some elements at Philadelphia, Pa.) is responsible for integrated commodity management of tactical communications, avionics, radar, automatic data processing, meteorology, night vision, combat surveillance, target acquisition, navigation and electronic warfare equipments and systems, as well as test equipment and tactical power sources. The Electronics Command is composed of approximately 13,500 civilians and military personnel assigned to 25 locations throughout the world, including the Night Vision Laboratory at Ft. Belvoir, Va.; Aviation Electronics Agency, St. Louis, Mo.; Electronics Research and Development Agency, and Atmospheric Sciences Laboratory, White Sands Missile Range, N.M.; and Meteorological Support Activity and Atmospheric Sciences Laboratory, Ft. Huachuca, Ariz.

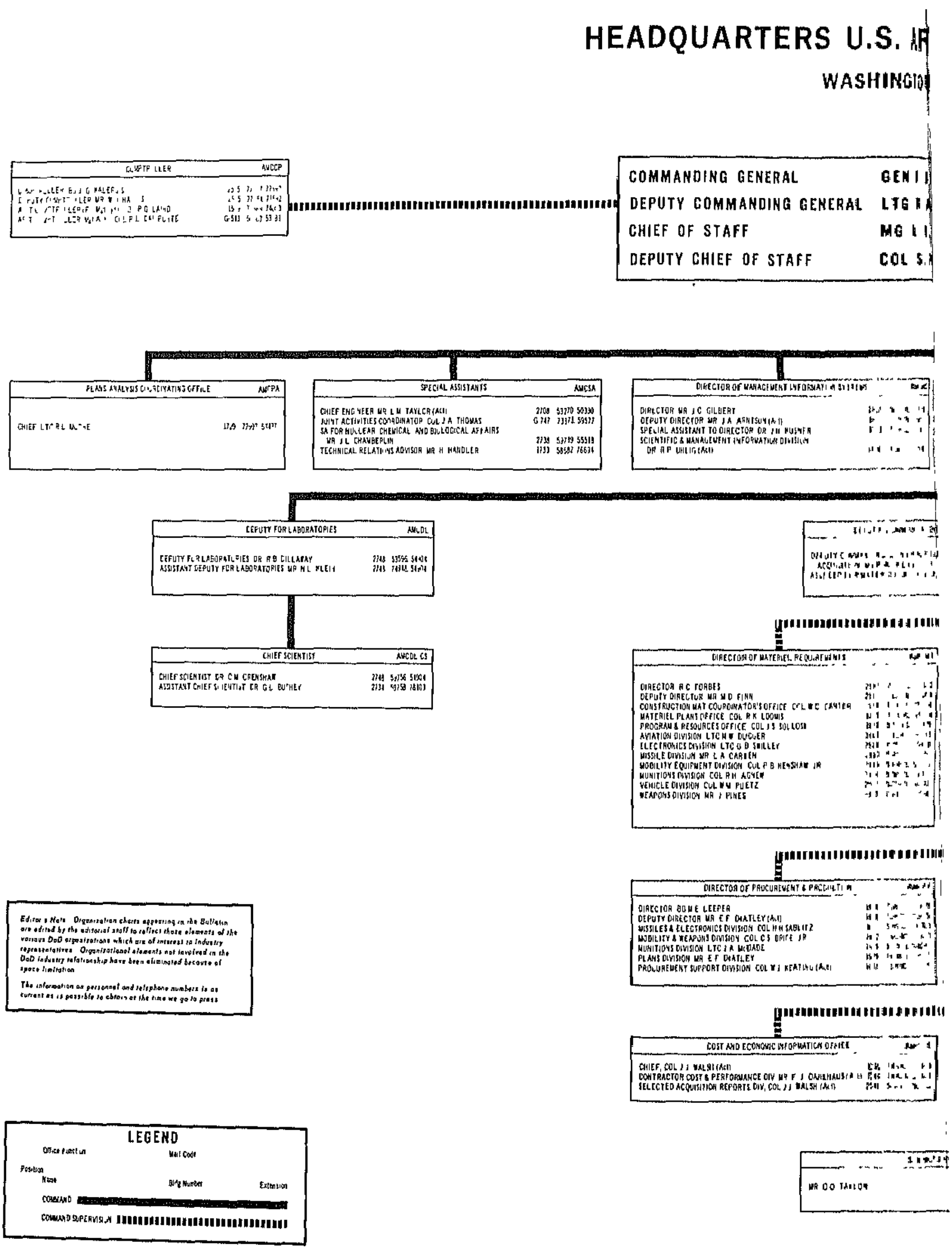
Army Aviation Systems Command, St. Louis, Mo., is responsible for integrated commodity management of aircraft and aerial delivery equipment. The command is composed of 10,000 military and civilian personnel located at the St. Louis headquarters, the Aeronautical Depot Maintenance Center, Corpus Christi, Tex.; Aviation Materiel Laboratories, Ft. Eustis, Va.; Aviation Test Activity, Edwards AFB, Calif.; and various production plant activities. The command also directs aeronautical missions at Atlanta, Ga., New Cumberland, Pa., Red River, Tex., and Lathrop, Calif.

Army Missile Command Redstone Arsenal, Ala., is responsible for integrated commodity management of assigned rocket, missile, and related programs. The command is composed of 11,000 military and civilian personnel. Small liaison offices are maintained at missile facilities and industrial locations throughout the United States and overseas, but a majority of the command mission is accomplished at Redstone Arsenal. The command does not manufacture weapon systems but maintains the scientific capability to monitor research, development, and production efforts of American industry.

Army Mobility Equipment Command St. Louis, Mo., is responsible for integrated materiel management of barriers and bridging, water purification equipment, construction equipment, power generators, materials and fuel handling equipment, industrial engines and turbines, environmental control equipment, and rail, marine, and amphibious equipment. The command is composed of 5,500 military and civilian personnel who are located at the St. Louis headquarters and the Army Mobility Equipment Research and Development Center, Ft. Belvoir, Va.; Marine Field Office, Hampton Roads, Va.; five mobility support offices throughout the United States and one each in Europe and the Pacific; and at five mobile railroad support shops in the United States.

Army Munitions Command, Picatinny Arsenal, Dover, N.J. is responsible for integrated commodity management of conventional, nuclear, chemical and biological munitions,

ASSISTANT GUNNER, PFC Bernard Covington of the 82nd Airb[illegible] sion, loads his AMC-procured 106mm recoilless rifle during combat in Vietnam.



Editor's Note: Organization charts appearing in the Bulletin are edited by the editorial staff to reflect those elements of the various DoD organizations which are of interest to industry representatives. Organizational elements not involved in the DoD industry relationship have been eliminated because of space limitation.

The information on personnel and telephone numbers is as current as is possible to obtain at the time we go to press.

1750	59154/59205	AMCCG
1742	59006/59571	AMCDCG
1742	59105/59107	AMCCS
1741	59576/59574	AMCDCS

GENERAL COUNSEL			AMCGC
GENERAL COUNSEL MR F M BARNES		440	52781 52615
ADVERSARY PROCEEDINGS DIVISION MR J T DAUGHERTY		431	59855 72263
PATENT LAW DIVISION CH MR H M SARAGOVITZ	Hass I	132	20115 20116
PROCUREMENT LAW DIVISION MR F X M KENNA		2636	74077 52647

INFORMATION OFFICE		AMCIO
INFORMATION OFFICER COL J H O'BRIEN	1062	7 491 35724
ASSOCIATE INFORMATION OFFICER MR D CRAIG	1062	7 491 35424
INDUSTRY LIAISON MR J J FOLEY	1.41	75515 55213
CLEARANCES MISS HARWELL	1 61	75515 59733

DIRECTOR OF QUALITY ASSURANCE		AMCQA
... J KORBER	2441	77597 53155
...ECTOR MR W C KRAUSE	2441	53197 53155
...NEERING DIVISION MR A H NORDSTROM JR	2440	73966 73946
...EERING DIVISION MR D E REDMON	2439	53157 74781
...ST DIVISION MR S WILLIAMS JR	2441A	78660 57203
...QUISITION DIVISION MR R F TINER	2433	73719 57701

PROJECT MANAGERS			AMCPM
CHAPARRAL/VULCAN COL R DALY	Nassif	524	21763 28783
MAIN BATTLE TANK MR O R LUCZAK		2537	51726 50045
MALLARD BG H W RICE (ECOM)		3124	70405 74624
LTC L Y TATE (Dep)			
MOBILE ELECTRIC POWER COL J J ROCHEFORT JR	Dwyer	101	47076 47079
SEA NIGHT OPERATIONS LTC C R LEHNER JR	Kel Tech	232	47598 751 522
SPECIAL MISSION OPERATIONS COL D U ARMSTRONG	Nassif	517	29030 29082

...VISION	AMCDMA
	1817 55217 55280
	1817 55217 56295

DEPUTY COMMANDING GENERAL FOR LOGISTICS SUPPORT		AMCDLS
DEPUTY COMMANDING GENERAL FOR LOGISTICS SUPPORT MG W N REDLING	3312	54892 54454
ASST DEPUTY FOR LOGISTICS SUPPORT MR E GREINER	3312	54149 54454

DIRECTOR OF INTERNATIONAL LOGISTICS		AMCIL
DIRECTOR MR M AMOTH (Act)	2601	54500 73074
DEPUTY DIRECTOR MR M AMOTH	2605	73074 54500
CO PRODUCTION MGT OFFICE LTC A L GOODALL	2629	71772 51567
SECONDARY ITEMS SUPPORT OFFICE MR BRUCE SMITH (Act)	2619	59159 73629
PLANS & PROCEDURES OFFICE COL W CUSSIE	2640	55773 73042
INTERNATIONAL DEVELOPMENT DIV, LTC L E WALTER	2654	79000 73371
FREE WORLD SUPPORT OFFICE MR A T HOLLAND (Act)	G 916	72470 72571
MILITARY SALES DIVISION COL H J GODFREY	2609	53472 76868

DIRECTOR OF MAINTENANCE		AMCMA
DIRECTOR BG A W KOGSTAD	2911	54601 54602
DEPUTY DIRECTOR MR C L KAPRCAK	2911	54672 54703
AIRCRAFT DIVISION LTC J A HAMMOND (Act)	2938	77215 77859
MISSILES & ELECTRONICS DIVISION COL L R HILLMAN	2903	55713 72935
PLANS & PROGRAMS OFFICE MR H A BRANDT	2921A	54046 78136
SUPPORT DIVISION MR H J BUKOWSKI	2908	72935 54713
VEHICLES & EQUIPMENT DIVISION COL C D MABRY	2974	52483 73167
WEAPONS & MUNITIONS DIVISION COL R W M POEHL	2976	73511 73316

DIRECTOR OF DISTRIBUTION & TRANSPORTATION		AMCDT
DIRECTOR BG T ANTONELLI	1085	50597/50596
DEPUTY DIRECTOR COL O SERBOUSEK	1087	50596 50595
CATALOGING & SUPPLY DATA MGT DIV COL W L ROGERS	G 913	56781 51892
PLANS & PROGRAMS OFFICE MR R W DEW	1331	51080 75987
STOCK MGT & CONTROL DIVISION MR M I HINSON	1312A	74677 76425
STORAGE DIVISION COL J M DuPARC	1701	57509
TRANSPORTATION DIVISION MR W W DUKE	1093	57509 76425
TROOP SUPPORT DIVISION, COL C H JOHNSTON	1814	52564 71073
WORLD WIDE LOGISTICS MGT OFFICE COL J O FLORIO	2901	55571 51994
POST HOSTILITIES LOGISTICS OPERATIONS LTC W R BRENT	1710	51407 55450

OPERATIONAL READINESS OFFICE		AMCOR
CHIEF COL W B DYER	G 911	50102 52582
ASST CHIEF COL A M FRAGALA	G 912	50112 52582
CUSTOMER ASSISTANCE DIVISION, COL A M FRAGALA	G 936	57774 57273
LOGISTIC READINESS DIVISION COL W R MILLER	G 937	71578 75072
PLANS DIVISION COL V C RAMBERG (Act)	G 9 6	77512 76019
AMC OPERATIONS CENTER, LTC R A BOYELL	1872	50456 53508
SA TO THE CG FOR NATIONAL GUARD LTC A J BUDAI	G 914A	77490 78713

SURVEILLANCE TARGET ACQUISITION AND NIGHT OBSERVATION (STANO) SYSTEMS OFFICE		AMCSO
... J E HOUSEWORTH III	2085	73723 55222
...NEERING COORDINATOR MR R F BRADY	2085	73723 55222
...NS COORDINATOR LTC J H GORDON	2087	55540 56785
...GRAMS COORDINATOR MR C V CHASZAR	2087	56785 55540
...IES COORDINATOR MR N A MOERMAN	2087	56785 55540
...ASTER COORDINATOR LTC G A RIZOR JR	2087	55540 56785

S/A FOR PROJECT MANAGEMENT		AMCSA PM
...ERQUIST	1727	72723/76768

	AMCDMAM
	1713 74662/72637

LIAISON

TO HEADQUARTERS AMC

UNITED KINGDOM LTC J H T REYNOLDS	2641	51589	AMCGS-B
CANADA, LTC D C BADENOCH	1712	50047	AMCGS-C
MAJ J E AYERS	1712	77693	AMCGS-C
GERMANY COL G VON SCHWEINITZ	1716	50103	AMCGS-G
MARINE CORPS MAJ J R CURL	1714	56563/75023	AMCGS-F
USAAA MR R L ROSS	G 526	78245 78339	AMCGS-R
USAMB MR C D DILL	2911	59358/70314	AMCGS-L

FROM HEADQUARTERS AMC TO

AFSC SPACE & MISSILE SYSTEMS DIV,* MR P DUEARA	433 1396	AMCISS
US ARMY FIELD OFFICE HQ AF SYSTEMS COMMAND* MR J PROCTOR	433 3300 X3727 1450 Code 133-3727 1450	AMCSA FLSCS-3
INFANTRY CENTER FT BENNING GA COL R H ROBINSON	433 1610 X545-2052	AMCLR
DoD PARACHUTE TESTING FACILITY* CAPT J C SIMPKINS	677 2011 X666-667	
MIT LINCOLN LABORATORY* (Boston Area) MR A D BEDROSIAN	410 1601 X71 671	
US NAVAL WEAPONS CENTER* MAJ G H KEY	690-1700, X77865, X72014	CODE 144
SANDIA BASE* COL OHL	553-3320 X6516 X4872	AMCFO
WRIGHT PATTERSON AIR FORCE BASE* MAJ C H PRICE	X52047	

*BLDG T 7, GRAVELLY POINT VA

with emphasis on defensive aspects. The command is composed of 30,000 military and civilian personnel at 35 installations and activities. The Ammunition Procurement and Supply Agency, Joliet, Ill., procures conventional ammunition, primarily through more than 20 government-owned, contractor-operated Army ammunition plants. Ft. Detrick, Md., performs the command's responsibilities with regard to biological agents. Edgewood Arsenal, Md., performs the command responsibilities with regard to chemical munitions through Pine Bluff Arsenal, Ark., Rocky Mountain Arsenal, Denver, Colo., and other facilities.

Army Tank-Automotive Command, Detroit Arsenal, Warren Mich., is responsible for integrated commodity management of general purpose vehicles weighing more than 10,000 pounds, tactical vehicles, and assigned combat vehicles. The command also performs major support functions for certain combat vehicles assigned to the Army Weapons Command. The Tank-Automotive Command is composed of 6,800 military and civilian personnel, nearly all of whom work in the headquarters and in the shops and laboratories of the arsenal. It also administers a tank production plant at the arsenal and the Pontiac Storage Plant, Mich.

Army Weapons Command, Rock Island, Ill., is responsible for integrated commodity management of artillery and infantry weapons, gun-type armament for aircraft, fire control equipment for weapons, and vehicles for which the predominant requirement is firepower, *i.e.*, self-porpelled artillery, tanks and tank-like vehicles including combat engineer vehicles and recovery vehicles. Additionally, the command is responsible for common type tools, equipment and sets used in Army maintenance shops. The command is composed of 12,000 military and civilian personnel who are located at the headquarters, at Rock Island Arsenal, and Watervliet Arsenal, N.Y.

Army Test and Evaluation Command, Aberdeen Proving Ground, Md., is responsible for engineering and service tests of Army materiel, test and evaluation support for the seven AMC commodity-type subordinate commands, and participation in preparation for troop tests conducted by the U.S. Continental Army Command. The command is composed of 19,000 military and civilian personnel located at 15 installations and activities. These include White Sands Missile Range, N.M., Arctic Test Center, Alaska; Tropic Test Center, Canal Zone; Air Defense, Armor, Artillery, Aviation, Infantry and Airborne, Electronics and Special Warfare service test boards at major Army posts, and a coast-to-coast network of proving grounds, test activities and test centers. (See *Defense Industry Bulletin*, "Reliable Equipment for Arctic, Jungle, Desert," Sept. 1969, p.1.)

Army Safeguard Logistics Command, Huntsville, Ala., the newest AMC subordinate command, was established April 15, 1968, to provide logistical support to the Safeguard System, the antiballistic missile system. The command's responsibilities include all aspects of inventory management and maintenance engineering necessary to support the Safeguard System. Its present strength is 250 military and civilian personnel.

Distribution and Supply System

Distribution of most of AMC's materiel is based on the MILSTRIP standard supply system. The normal requisitioning chain overseas under MILSTRIP is from the using unit to a support unit which, in turn, requisitions the theater inventory control center. From the theater, requests flow directly to one of the sources of supply, *i.e*, a National Inventory Control Point. Requisitioning procedures are similar in the United States.

In some situations, such as a critical shortage of repair parts overseas, the command has used special supply systems. For example, project "Red Ball Express," was established in 1965 when difficulty was experienced in keeping some major items of equipment operational in Vietnam. Under this system, the flow of requisitions moves from Vietnam directly to the National Inventory Control Point in the United States, and a single agency is responsible for filling the requisitions.

The receipt, storage, issue, and maintenance support for AMC's thousands of weapons, equipment, and supply items is accomplished by a coast-to-coast system of 19 depots. The system fills an average of 500,000 individual requisitions a month from users of AMC material throughout the world.

These depots range from compact complexes of offices, warehouses, laboratories, and maintenance shops near urban centers to huge isolated installations with up to 90,000 acres of open storage. Most of the depots handle general supplies plus specific commodities, such as ammunition and vehicles. Some provide support to the Defense Supply Agency. The Fort Wingate Depot, Gallup, N.M., handles only ammunition. Although the primary purpose of the AMC depots is to store and issue materiel required for Army use, some 5 million tons of the 9 million tons of materiel currently stocked in these depots is stored for other agencies.

The command has 17 research and development laboratories or centers. Eleven of these are specialized laboratories which support the missions of the AMC subordinate commands. Most of the Army's in-house capability for basic and applied research is in the five laboratories and centers that report directly to AMC headquarters.

The center at Aberdeen, Md., conducts research that ranges from weapon systems evaluation and lubricants to human factors capabilities and nuclear weapons effects in areas of radiation and fallout. Basic research on metals, armor and ceramics is conducted at a center in Watertown, Mass. The Harry Diamond Laboratories in Washington, D.C., has research reponsibilities that include target detection, weapon system synthesis and analysis. Research on food, clothing, footwear, aerial delivery and general equipment for the soldier is conducted at the Natick Laboratories, Natick, Mass. The Aeronautical Research Laboratory, Moffett Field, Calif., is interested in subsonic aerodynamics, wind tunnel operation and aeronautical resistance in low-space flights.

AMC's highly technical operations require professional development of its personnel. AMC operates three major logistics service schools for the Army.

The three AMC schools—Army Logistics Management Center, Ft. Lee, Va.; Army Management Engineering Training Agency, Rock Island, Ill

and the Joint Military Packaging Training Center, Aberdeen, Md.—are characterized by many relatively short courses. Directly administered by Headquarters, AMC, these schools train 10,000 students annually.

A number of "in-house" programs give training in specific commodity or functional fields. These include programs dealing with safety, quality assurance, metal tests and inspection, materiel deterioration and corrosion control, and ammunition inspection and surveillance.

The personnel of these schools also develop technical manuals, provide consultant services, and conduct specialized research.

Project Management

One of the most unusual programs AMC has is the "Project Manager System." A modern look has been given to traditional military management in the guise of this system. AMC has made the most widespread application ever undertaken of the project/product manager concept.

An early analysis of AMC operations showed that a relatively small number of programs account for nearly 50 percent of the research and development expenditures and more than 50 percent of the production expenditures. These programs were given special management attention by placing them under the project/product managership concept.

The criteria used to identify such weapon or equipment programs for project management include criticality of the weapon/equipment to the defense of the United States; urgency of getting the weapon/equipment into the hands of using units; complexity of the weapon/equipment requiring participation to an unusual degree of two or more major subordinate commands; and estimated high cost of a weapon/equipment.

The project manager directs the activities to be carried out and is the single individual with authority, responsibility and funds to accomplish his program objective. Currently 45 projects are under the single manager concept.

The past and future success of AMC, of course, is dependent to a great extent on its interface with civilian science and industry. The command has an extensive network of research and production facilities available in scientific, technical and productive areas, but it could not begin to accomplish its logistical mission without the massive support and participation of civilian business and industry.

Industry is advised of the Army's requirements through such AMC programs as advance planning briefings, qualitative requirements information, advance planning procurement information, and procurement fairs; through advertising in the official *Commerce Business Daily*, and through direct mailing of invitations for bid (IFB) and requests for proposal (RFP). Industry responds through the unsolicited proposals and company-funded study programs, as well as through answers to selected IFBs and RFPs.

AMC has five procurement offices: Chicago, Cincinnati, New York, San Francisco, and Los Angeles. Information concerning the preparation and submission of bids is readily available in these offices, as well as in the headquarters of the commodity commands. Officials are available at all AMC facilities for person-to-person interviews concerning future requirements and industry's capabilities for fulfilling them. An Army-Industry Liaison Office is maintained in the

AMC's BASIC MISSION is to keep the U.S. soldier equipped and supplied for whatever job he is called upon to perform.

Washington, D.C., headquarters. The subordinate commands and activities offer similar service to industry representatives.

The Army and AMC have come a long way since "Black Jack" Pershing used a tractor to move supply wagons during his expedition into Mexico; since mules packed ammunition and supplies to American troops in the mountains of Italy; since the old two-and-a-half ton truck bussed American troops and supplies around and over the cold, bleak hills of Korea. Today, in Vietnam, helicopters speed troops hundreds of miles across terrain impassable to wheeled vehicles. Soldiers arrive on the battlefield fresh for combat.

AMC's basic mission, of course is to keep its most important customer—the U.S. soldier—equipped and supplied for whatever job he is called upon to perform.

AMC strives to use the newest tools and principles of management to ensure the huge, complex administrative and service apparatus meshes with the production apparatus of the nation's economy with maximum efficiency.

Flexible Bulk Fuel Containers Tested by Army

Four elastomer-coated fabric bulk fuel tanks are under development by the Army Mobility and Equipment Research and Development Center, Fort Belvoir, Va. Field tests of the fuel reservoirs, with capacities of 1,250, 2,500, 5,000 and 25,000 barrels each, are being conducted by elements of the Test and Evaluation Command, Aberdeen Proving Ground, Md.

The tanks are intended for use in areas where temporary petroleum storage facilities are needed. The equipment is expected to reduce shipping requirements, construction time, and skilled manpower needs.

Estimated installation time for the ırge reservoir will be only 20 percent ıat required for conventional bolted · welded steel tankage of like caıcity. The 6,200-pound envelope-like ɔntainer is designed for installation ʼ engineer construction troops. Oper-.tion of the completed tanks will be andled by petroleum-oil-lubricant ınit quartermasters.

Small Business Share in FY 1969

Small Business Share of Defense Procurement

(Dollars in Thousands)

Type of Firm and Category of Procurement	Fiscal Year 1969 Jul 68–Jun 69	Fiscal Year 1968 Jul 67–Jun 68
Defense Procurement (Prime Contracts) From All Business Firms—Total	$37,986,280	$10,304,066
Missile and Space Systems	5,238,625	4,732,136
Aircraft	8,316,897	9,470,027
Other Major Hard Goods	11,671,965	12,277,569
Services	2,934,176	3,234,257
Commercial Items, Construction and All Purchases under $10,000	9,169,433	9,772,629
Civil Functions	655,184	817,448
Defense Procurement (Prime Contracts) From Small Business Firms—Total	$6,765,378	7,583,890
Missile and Space Systems	94,211	91,498
Aircraft	242,603	264,463
Other Major Hard Goods	1,153,028	1,428,873
Services	658,294	840,843
Commercial Items, Construction and All Purchases Under $10,000	4,367,395	4,642,416
Civil Functions	249,847	315,797
Percentage of Defense Prime Contract to Small Business Firms—Total	17.8	18 8
Missile and Space Systems	1.8	1.9
Aircraft	2.9	2.8
Other Major Hard Goods	9.9	11.6
Services	22.5	26.0
Commercial Items, Construction and All Purchases Under $10,000	47 6	47.5
Civil Functions	38.1	38.6
Subcontracts		
Number of Reports from Large Business Firms	946*	886
Subcontract Commitments by Reporting Large Business Firms	$14,902,354*	15,224,920
Commitments to Small Business Firms	6,043,176	6,495,762
Percent to Small Business	40.6	42.7

* Preliminary, Subject to Revision.

Table 1

Note: Statistics contained in Tables 1 and 2 were compiled by the Deputy Comptroller for Information Services, Office of the Secretary of Defense (Comptroller), Washington, D.C. 20301.

Defense Contracts, RDT&E

Small business firms were awarded $6,765 million in defense prime contract awards during FY 1969, $819 million less than the amount awarded during FY 1968. Of the total value of prime contract awards to business firms, small business received 17.8 percent during FY 1969 compared with 18.8 percent during FY 1968.

Contributing to the decline in the small business percentage was the rise in the dollar volume of missile and space systems and of ammunition (included in "Other Major Hard Goods"), which provide only limited opportunities for small business. This rise, in conjunction with decreased dollar volumes in commercial items, services and civil functions categories, which are favorable to small business, adversely affected the small business ratio. Additionally, small business obtained a smaller proportion of awards in the services category and in a number of sub-categories comprising the "Other Major Hard Goods" category.

Data on subcontract commitments to small business firms are shown in Table 1. Commitment data are obtained from large business firms which received prime contract awards of $500,000 or more having substantial subcontracting possibilities. The reporting large business firms committed a total of $14,902 million in subcontracts during FY 1969, of which $6,043 million, or 40.6 percent went to small business firms. Subcontract commitments during FY 1968 were $15,225 million, of which $6,496 million, or 42.7 percent, went to small business firms.

Prime contract awards for research, development, test and evaluation (RDT&E) work are included in Table 1 and are shown separately in Table 2. Small business firms were awarded $198 million in RDT&E prime contracts during FY 1969, an increase of $2 million over FY 1968. Of the total RDT&E prime contracts awarded to business firms, small business received 3.7 percent during FY 1969, compared with 3.4 percent during FY 1968.

Procurement for Research, Development, Test and Evaluation

(Dollars in Thousands)

Type of Firm and Department	Fiscal Year 1969 Jul 68–Jun 69	Fiscal Year 1968 Jul 67–Jun 68
Total	$5,320,090	$5,777,965
Army	1,074,739	1,152,754
Navy	1,393,310	1,476,768
Air Force	2,852,041	3,148,443
Small Firms	197,583	195,602
Army	60,373	57,483
Navy	80,409	83,827
Air Force	56,801	54,292
Other Firms	5,122,507	5,582,363
Army	1,014,366	1,095,271
Navy	1,312,901	1,392,941
Air Force	2,795,240	3,094,151
Small Firms as a Percent of Total	3.7	3.4
Army	5.6	5.0
Navy	5.8	5.7
Air Force	2.0	1.7

Table 2

DOD Announces Actions To Reduce Military Activities

The Secretary of Defense has directed 280 specific actions to consolidate, reduce, realign, or discontinue military installations and activities in the United States and Puerto Rico. No major base closures are included.

When completed, these actions, together with 27 other actions overseas, will reduce expenditures approximately $609 million annually. About 37,800 military and 27,000 civilian positions will be eliminated. This reduction is part of the FY 1970 defense expenditure cut of up to $3 million announced earlier.

The services of the DOD Office of Economic Adjustment will be made available to communities affected by the reductions.

Decisions involving overseas instal lations will not be announced until ne essary consultations are comp with the host countries. Overse ductions do not effect activit Korea, Thailand, or Vietnam.

No bases in Europe are bei and reductions in military p are insignificant. Decision ha been reached on the ultimate di of those installations in the States and Puerto Rico which are to be closed as a result of the realignment actions.

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DOD To Acquire New Family of Computer Systems

The Defense Department has approved plans to acquire a new family of standardized computer systems for use in the World-Wide Military Command and Control System (WWMCCS), and associated portions of the Intelligence Data Handling System (IDHS).

Under the program, authorization has been given for 34 new computing systems, with an option for 53 additional computers. The Air Force Electronics Systems Division (ESD), L. G. Hanscom Field, Mass., will be responsible for procurement, with responsibility for machine allocation and software development going to the Joint Chiefs of Staff.

The procurement represents the first phase of a standardization program that began with desireability and feasibility studies in 1966 by the Joint Chiefs of Staff and the Military Departments. Specifications were then drawn up by a joint working group. Plans allow the development of additional specifications to accommodate future advances in computer technology, to precede the next buy expected in 1972.

The procurement represents the first time the computing needs of many users will be satisfied by systems acquired from a single source. Individual requirements of the separate activities will be accommodated by providing configurations of the central processing unit and peripheral equipment tailored to the needs of the user.

The WWMCCS and IDHS includes 55 activities utilizing 131 computer systems.

Advantages of a standard family of computers include improved data interchange and data distribution, less duplication in the development of applications and support programs, lower unit costs, elimination of time and money costs involved in individual selections, better utilization and performance of computers, and reduced logistical and training costs.

Features of the software program include multi-programming capability for all computer systems, multi-processing for the large computers, online data files with multi-level security, and compilers for Fortran, Cobal and Jovial, the standard high order programming languages.

Not provided for are inclusions of communications processors, display consoles, or optical readers.

FAAS-85 Study Proposes Future Army Aircraft

The Army Combat Developments Command, Fort Belvoir, Va., has completed its Family of Army Aircraft Study 1970-1985 (FAAS-85). It proposes a family of aircraft with subfamilies to support the basic combat functions of firepower, mobility, service support, intelligence, and command and control.

The master plan also proposes concept formulation, developmental and phase-in schedules to give a year-by-year picture of current and future aircraft through the next 15 years.

Included in the overall consideration are the Utility Tactical Transport Aircraft System (UTTAS), the Heavy Lift Helicopter (HLH), the Very Heavy Lift Helicopter (VHLH), a variety of short take-off and landing (STOL) aircraft, manned or drone surveillance, target acquisition and intelligence aircraft, the follow-on Huey Cobra, and the Tactical Assault Supply Transporter (TAST).

FAAS-85 was initiated as the focal point for future studies and efforts defining and evaluating doctrine, organization and materiel requirements for Army aviation through 1985.

Status of Funds Quarterly Report

Outlays

Fourth Quarter, Fiscal Year 1969
(Thousands of Dollars)

Department of Defense

	Outlays				Unpaid obligations	
	April 1969	May 1969	June 1969	Cum thru 30 June 1969	At start of year	As of 30 June 1969
Military Personnel						
Active forces	1,728,741	1,720,375	1,971,523	20,481,815	761,917	592,305
Reserve forces	60,797	66,703	94,929	891,761	149,746	152,294
Retired pay	213,151	213,967	215,302	2,444,071	6,880	6,354
Undistributed	108,205	55,192	4,620	-	—	-
Total—Military Personnel	2,110,897	2,056,238	2,286,373	23,817,617	918,543	750,955
Operation and Maintenance	1,926,578	1,850,962	2,440,750	22,227,060	4,033,198	3,921,991
Procurement						
Aircraft	768,034	707,253	674,341	9,179,088	9,591,226	7,710,256
Missiles	213,187	211,555	280,082	2,509,100	2,069,735	2,531,668
Ships	178,508	175,829	174,787	1,948,758	3,447,418	3,085,254
Tracked combat vehicles	52,660	27,564	65,982	481,151	610,190	451,414
Ordnance, vehicles and related equipment	532,315	619,320	928,597	6,623,140	6,595,367	5,705,929
Electronics and communications	129,607	78,168	167,701	1,411,816	1,881,331	1,661,653
Other procurement	177,992	141,493	155,462	1,883,647	2,056,183	2,031,665
Undistributed	—43,509	—42,715	—290,963	—2,410	—7,225	- 1,815
Total—Procurement	2,008,796	1,921,470	2,155,087	23,987,590	26,241,228	23,215,023
Research, Development, Test, & Evaluation						
Military sciences	86,390	80,087	91,937	982,948	777,774	716,763
Aircraft	44,533	123,073	176,492	1,026,896	717,151	687,974
Missiles	200,813	213,142	211,546	2,317,535	983,018	1,085,044
Astronautics	100,957	110,574	56,516	1,155,627	487,480	20,412
Ships	26,480	40,009	28,806	329,481	245,270	290,815
Ordnance, vehicles and related equipment	30,268	35,421	33,915	336,322	216,577	668,182
Other equipment	66,243	73,375	82,106	783,468	478,981	509,562
Program-wide management and support	29,661	25,352	81,684	525,013	189,338	282,937
Undistributed	—12,717	—16,113	15,362	—993	—1,633	- 610
Total—Research, Development, Test, & Evaluation	572,625	685,891	731,364	7,457,226	4,091,265	4,261,084
Military Construction	153,877	36,413	148,626	1,388,656	1,781,255	1,806,093
Family Housing	53,643	50,242	59,175	573,376	174,687	256,916
Civil Defense	6,773	6,999	6,125	86,887	80,629	55,255
Other—Special Foreign Currency Program	300	43	143	1,289	1,071	363
Revolving and Management Funds	—139,171	—120,136	—551,928	—1,535,160	6,078,411	6,615,210
Subtotal—Military Functions-Federal Funds	6,694,318	6,488,121	7,273,916	78,004,572	43,409,287	40,885,950
Military Assistance—Federal Funds	52,218	78,386	147,578	685,541	1,823,031	1,562,839
Grand Total—Federal Funds	6,746,536	6,566,507	7,421,493	78,690,112	45,232,322	42,448,788
Total—Military Functions-Bud Concept adj.	—12,342	—8,044	—9,801	—126,171	8,794	4,544
Total—Mil Assistance-Bud Concept adj	—8,129	—27,465	—11,761	103,319	433,454	227,015
Grand Total—Budget Concept adjustments	—20,471	—35,509	—21,562	—22,852	442,248	231,549
TOTAL—DEPARTMENT OF DEFENSE	6,726,066	6,530,998	7,399,931	78,667,260	45,674,570	45,680,337

Department of the Army

	April 1969	May 1969	June 1969	Cum thru 30 June 1969	At start of year	As of 30 June 1969
Military Personnel						
Active forces	725,402	701,114	916,446	8,460,678	382,077	213,718
Reserve forces	36,329	11,002	63,994	586,709	112,578	115,658
Undistributed	87,896	53,141	37,146	—	—	-
Total—Military Personnel	849,627	798,557	1,017,586	9,017,387	494,651	329,157
Operations and Maintenance	717,599	672,057	995,139	8,299,710	1,541,708	1,337,348
Procurement						
Aircraft	93,108	89,252	109,278	1,128,169	1,343,518	1,066,700
Missiles	68,811	44,652	87,175	593,355	629,712	856,169
Tracked combat vehicles	50,974	26,041	64,349	465,061	586,046	431,069
Ordnance, vehicles, and related equipment	212,414	280,642	361,084	2,914,395	3,445,481	2,972,083
Electronics and communications	48,767	16,468	84,025	490,148	688,774	598,599
Other procurement	58,346	47,967	18,016	528,028	769,510	692,824
Undistributed	2,606	—33,894	—323,722	—2,410	—7,225	- 1,815
Total—Procurement	525,027	471,129	430,234	6,116,741	7,455,816	6,612,627
Research, Development, Test, and Evaluation						
Military sciences	21,610	11,118	11,639	126,091	98,272	98,697
Aircraft	4,572	7,440	10,573	98,597	78,199	91,757
Missiles	61,037	74,800	76,793	692,981	386,366	423,738
Astronautics	349	1,243	1,281	9,485	7,865	3,999
Ordnance, vehicles, and related equipment	13,520	13,961	18,166	166,556	110,632	110,864
Other equipment	23,210	27,471	44,524	343,944	196,748	201,122
Program-wide management and support	5,211	5,421	9,848	84,179	83,898	32,294
Undistributed	—15,283	—17,741	—10,152	—993	—1,633	- 610
Total—Research, Development, Test, & Evaluation	114,226	123,713	162,672	1,520,840	910,247	967,831
Military Construction	82,057	—19,502	34,679	460,209	768,016	776,104
Revolving and Management Funds	—2,892	—12,771	—306,139	—347,902	1,955,905	1,850,891
Army—Federal Funds	2,285,644	2,033,185	2,334,168	25,096,984	13,126,377	11,880,257
Army—Budget Concept adjustments	—7,170	—2,144	—5,377	—61,792	10	89
TOTAL—DEPARTMENT OF THE ARMY	2,278,475	2,031,041	2,328,790	25,035,191	13,126,387	11,880,346

Department of the Navy

	Outlays				Unpaid obligations	
	April 1969	May 1969	June 1969	Cum thru 30 June 1969	At start of year	As of 30 June 1969
Military Personnel						
Active forces	507,255	529,418	569,814	5,990,701	225,093	168,734
Reserve forces	12,639	13,415	15,789	152,792	22,898	23,320
Undistributed	21,057	1,952	—32,698	—	—	—
Total—Military Personnel	540,951	544,815	552,905	6,143,496	247,991	192,054
Operation and Maintenance	480,979	472,507	655,711	5,767,299	1,466,352	1,537,613
Procurement						
Aircraft	233,693	260,579	240,804	2,821,054	3,218,049	2,897,891
Missiles	50,707	48,144	60,586	534,165	547,934	713,622
Ships	178,508	175,829	174,787	1,918,758	3,447,418	3,085,253
Tracked combat vehicles	1,686	1,528	1,633	19,090	24,141	23,346
Ordnance, vehicles, and related equipment	141,532	183,357	291,778	1,828,471	1,713,931	1,511,137
Electronics and communications	50,197	33,846	48,552	517,409	645,301	590,275
Other procurement	92,057	78,575	82,361	853,665	1,143,225	1,108,318
Undistributed	—51,652	7	19,931	—	—	—
Total—Procurement	699,729	781,859	920,435	8,522,612	10,740,005	10,053,142
Research, Development, Test, and Evaluation						
Military sciences	17,497	15,251	18,737	195,450	121,458	130,580
Aircraft	30,937	43,916	61,947	386,337	257,524	257,544
Missiles	54,024	51,156	45,904	653,101	258,025	292,722
Astronautics	1,873	1,702	2,457	21,393	16,259	16,413
Ships	26,480	40,009	28,806	329,481	245,279	290,845
Ordnance, vehicles and related equipment	16,748	21,460	15,749	169,766	106,045	111,328
Other equipment	9,781	11,517	12,589	126,750	79,604	78,238
Program-wide management and support	2,331	—10,112	1,732	163,201	133,064	219,718
Undistributed	1,553	1,158	—8,923	—	—	—
Total—Research, Development, Test, & Evaluation	164,224	175,760	181,998	2,045,479	1,217,258	1,100,388
Military Construction	37,275	13,682	68,495	424,838	573,575	616,207
Revolving and Management Funds	—76,116	—30,422	—135,368	—350,083	2,269,078	2,199,935
Navy—Federal Funds	1,846,011	1,958,202	2,214,176	22,543,641	16,514,258	15,999,338
Navy—Budget Concept adjustments	—2,390	—4,879	—2,136	—36,153	110	122
TOTAL—DEPARTMENT OF THE NAVY	1,843,651	1,953,322	2,212,041	22,507,488	16,514,368	15,999,460

Department of the Air Force

	April 1969	May 1969	June 1969	Cum thru 30 June 1969	At start of year	As of 30 June 1969
Military Personnel						
Active forces	196,087	186,513	185,263	6,030,433	154,717	209,774
Reserve forces	11,829	12,256	15,146	152,260	14,270	13,316
Undistributed	—748	99	172	—	—	—
Total—Military Personnel	507,168	198,898	500,581	6,182,693	169,017	223,090
Operation and Maintenance	633,833	613,975	691,128	7,073,158	927,881	953,240
Procurement						
Aircraft	141,233	357,422	324,259	5,229,865	5,029,659	3,775,665
Missiles	103,669	121,759	132,321	1,381,580	892,089	961,878
Ordnance, vehicles, and related equipment	175,356	155,294	275,671	1,877,439	1,434,835	1,189,270
Electronics and communications	29,460	27,258	34,476	395,152	539,008	471,403
Other procurement	24,711	8,233	16,193	409,459	100,001	97,071
Undistributed	578	—2,639	13,176	—	—	—
Total—Procurement	775,007	667,329	796,395	9,293,795	7,995,592	6,498,290
Research, Development, Test, & Evaluation						
Military sciences	9,241	12,904	14,967	156,020	104,162	92,294
Aircraft	9,024	71,687	100,972	541,962	381,728	338,673
Missiles	85,752	87,186	88,849	971,453	338,627	368,584
Astronautics	98,735	107,629	52,778	1,121,719	463,356	436,990
Other equipment	33,252	31,887	24,993	312,774	202,629	230,202
Program-wide management and support	22,119	30,373	20,104	278,563	22,376	30,925
Undistributed	—1,987	1,440	31,437	—	—	—
Total—Research, Development, Test, & Evaluation	266,134	345,605	337,102	3,385,521	1,512,878	1,497,668
Military Construction	36,059	40,822	45,196	493,544	425,858	393,810
Revolving and Management Funds	—14,000	—40,658	—37,617	—507,918	521,170	1,276,941
Air Force—Federal Funds	2,193,200	2,125,973	2,332,785	25,920,764	11,552,396	10,813,039
Air Force—Budget Concept adjustments	—2,780	—1,017	—2,523	—28,143	8,675	1,323
TOTAL—DEPARTMENT OF THE AIR FORCE	2,190,420	2,124,956	2,330,262	25,892,321	11,561,071	10,847,362

Defense Agencies/Office of the Secretary of Defense

	Outlays				Unpaid obligations	
	April 1969	May 1969	June 1969	Cum thru 30 June 1969	At start of year	As of 30 June 1969
Military Personnel						
Retired Pay	213,151	213,967	215,902	2,444,071	6,880	6,351
Operations and Maintenance	94,167	92,423	98,771	1,096,892	97,258	96,790
Procurement						
Ordnance, vehicles, and related equipment	14	27	64	3,135	1,117	119
Electronics and communications	1,183	596	648	8,807	8,251	7,376
Other procurement	2,878	6,718	8,859	42,500	43,417	11,414
Undistributed	4,959	—6,189	—648			
Total—Procurement	9,034	1,152	8,923	54,142	52,815	58,971
Research, Development, Test, & Evaluation Military sciences	38,042	10,811	49,594	505,387	453,882	395,197
Military Construction	486	1,411	257	10,066	16,777	19,972
Family Housing	53,613	50,242	59,475	573,376	171,687	256,916
Other—Special Foreign Currency Program	300	43	143	1,289	1,071	464
Revolving and Management Funds	—46,162	—36,286	—75,801	—929,227	1,332,258	1,281,471
Defense Agencies—Federal Funds	362,661	363,762	356,661	4,356,296	2,135,698	2,108,061
Defense Agencies—Budget Concept adjustments	—1	—2	235	218		
TOTAL—DEFENSE AGENCIES	362,657	363,760	356,896	4,356,514	2,135,628	2,108,061

Office of Civil Defense

	April 1969	May 1969	June 1969	Cum thru 30 June 1969	At start of year	As of 30 June 1969
Civil Defense	6,773	6,999	6,125	86,887	80,629	55,255
Revolving and Management Funds	—	—				
TOTAL—OFFICE OF CIVIL DEFENSE-FED. FUNDS	6,773	6,999	6,125	86,887	80,629	55,255

Military Assistance

	April 1969	May 1969	June 1969	Cum thru 30 June 1969	At start of year	As of 30 June 1969
Military Personnel	38	14	30	280	353	117
Operation and Maintenance	19,802	50,394	36,436	284,164	230,810	270,006
Procurement						
Aircraft	8,957	10,420	17,462	109,303	226,880	159,225
Missiles	643	319	—3,372	2,315	16,035	8,779
Ships	1,143	1,357	6,013	24,091	43,984	78,612
Ordnance, vehicles, and related equipment	9,562	9,989	20,492	134,389	192,738	111,910
Electronics and communications	2,333	4,300	8,905	59,135	101,236	79,415
Other procurement	3,497	5,320	7,616	45,515	88,120	76,054
Total—Procurement	26,125	31,705	57,147	375,078	669,292	516,110
Research, Development, Test, & Evaluation	—	—	—	10	36	10
Military Construction	307	2	219	2,082	6,809	1,749
Revolving Fund	1,162	28,402	26,813	61,341	848,233	736,295
Undistributed	4,785	—32,132	26,931	—27,401	67,472	5,652
Subtotal—Military Assistance	52,218	78,386	147,578	685,511	1,823,031	1,562,849
Total—Military Assistance-Bud Concept adjustments	—8,129	—27,465	—11,761	103,319	433,451	227,015
TOTAL—MILITARY ASSISTANCE	41,089	50,921	135,817	788,860	2,256,488	1,789,856

Obligations

Department of Defense

	Available for Obligation	Obligations				Unobligated balance 30 June 1969
		April 1969	May 1969	June 1969	Cum thru 30 June 1969	
Military Personnel						
Active forces	20,699,465	1,691,999	1,722,490	1,768,610	20,693,058	6,407
Reserve forces	935,312	66,521	81,430	121,571	899,176	36,136
Retired pay	2,450,000	212,952	213,797	214,611	2,442,911	7,059
Total—Military Personnel	21,081,767	1,971,473	2,017,723	2,104,803	24,036,176	49,593
Operation and Maintenance	24,719,988	2,076,121	1,863,040	2,659,279	21,601,660	116,419
Procurement						
Aircraft	11,255,494	450,152	308,131	1,327,991	7,770,553	3,181,941
Missiles	4,131,858	213,211	212,104	341,703	3,093,224	1,018,643
Ships	3,629,245	99,843	148,680	176,533	1,665,620	1,961,625
Tracked combat vehicles	486,156	16,508	28,825	81,839	393,308	92,847
Ordnance, vehicles and related equipment	9,793,100	405,999	243,563	488,801	7,772,690	2,020,416
Electronics and communications	2,395,381	91,719	152,688	276,402	1,359,793	1,035,588
Other procurement	3,241,186	150,595	170,341	393,532	2,373,201	867,925
Undistributed	503,292	—	—			503,292
Total—Procurement	35,435,716	1,428,035	1,264,331	3,086,803	21,428,419	11,007,297
Research, Development, Test & Evaluation						
Military sciences	1,142,580	69,805	70,906	155,825	1,001,600	147,971
Aircraft	1,172,893	30,937	150,013	103,238	1,000,792	172,101
Missiles	2,702,607	164,878	118,402	185,992	2,551,231	151,374
Astronautics	1,282,062	56,442	77,368	67,863	1,221,009	61,051
Ships	468,317	18,281	23,367	47,839	401,160	61,157
Ordnance, vehicles, and related equipment	419,666	10,404	19,004	40,936	355,810	63,826
Other equipment	1,047,805	87,469	60,994	112,004	842,403	205,402
Program-wide management and support	1,066,465	71,847	57,334	160,711	1,021,741	43,721
Emergency Fund	—	—	—	—	—	
Undistributed	48,014	—	—	—	—	48,014
Total—Research, Development, Test & Evaluation	9,350,309	518,563	577,390	874,405	8,401,785	918,524
Military Construction	3,499,621	155,191	172,686	258,704	1,929,213	1,570,408
Family Housing	740,433	56,147	28,063	62,170	674,091	72,123
Civil Defense	69,205	2,215	4,084	9,580	64,353	4,852
Other	15,742	22	111	87	680	15,162
Subtotal—Military Functions	97,921,781	6,206,765	5,927,427	9,055,782	84,138,296	13,783,485
Military Assistance	682,061	21,455	117,636	138,187	620,631	61,430
TOTAL—DEPARTMENT OF DEFENSE	98,603,842	6,228,220	6,045,063	9,193,969	84,758,927	13,844,915

Department of the Army

	Available for Obligation	Obligations April 1969	May 1969	June 1969	Cum thru 30 June 1969	Unobligated balance 30 June 1969
Military Personnel						
Active forces	8,519,997	705,217	709,818	757,317	8,519,997	—
Reserve forces	609,584	42,206	55,211	87,607	589,501	20,083
Total—Military Personnel	9,129,581	747,423	765,028	844,925	9,109,498	20,083
Operation and Maintenance	9,241,195	728,467	809,638	1,118,843	9,191,301	49,895
Procurement						
Aircraft	1,207,303	103,370	49,273	180,632	875,405	331,898
Missiles	1,065,269	31,543	43,731	70,616	906,765	158,504
Tracked combat vehicles	457,334	14,132	27,254	79,913	375,017	82,317
Ordnance, vehicles and related equipment	5,821,354	212,061	127,612	294,749	4,471,874	1,349,480
Electronics and communications	948,494	30,215	27,717	136,196	487,929	460,565
Other procurement	888,171	43,854	65,828	159,556	533,914	354,257
Undistributed	105,053	—	—	—	—	105,053
Total—Procurement	10,492,978	435,175	341,115	921,692	7,650,904	2,842,074
Research, Development, Test, & Evaluation						
Military sciences	198,123	10,411	10,894	21,515	175,273	22,850
Aircraft	168,271	5,693	5,378	16,182	114,869	53,402
Missiles	795,956	39,209	22,207	56,154	738,376	57,580
Astronautics	11,851	355	474	1,000	5,694	6,157
Ordnance, vehicles and related equipment	223,697	7,517	12,390	26,116	177,418	46,279
Other equipment	497,002	27,107	33,627	48,910	366,503	130,499
Program-wide management and support	99,340	6,645	5,334	8,673	88,950	10,390
Undistributed	10,634	—	—	—	—	10,634
Total—Research, Development, Test & Evaluation	2,004,874	96,967	90,303	178,550	1,667,083	337,791
Military Construction	1,483,312	73,188	46,069	122,284	712,805	770,506
TOTAL—DEPARTMENT OF THE ARMY	32,351,941	2,081,221	2,052,451	3,186,295	28,331,591	4,020,350

Department of the Navy

	Available for Obligation	Obligations April 1969	May 1969	June 1969	Cum thru 30 June 1969	Unobligated balance 30 June 1969
Military Personnel						
Active forces	6,041,427	509,203	519,476	524,810	6,041,427	—
Reserve forces	165,798	11,694	13,589	16,828	156,969	8,829
Total—Military Personnel	6,207,225	520,897	533,065	541,638	6,198,396	8,829
Operation and Maintenance	6,736,287	618,051	422,545	763,008	6,720,351	15,936
Procurement						
Aircraft	3,430,516	101,050	186,762	314,073	2,550,627	879,889
Missiles	979,347	21,619	41,604	72,548	720,828	258,519
Ships	3,629,245	99,843	148,680	176,533	1,665,620	1,963,625
Tracked combat vehicles	28,822	2,376	1,571	1,927	18,292	10,530
Ordnance, vehicles and related equipment	2,050,552	93,839	90,597	91,961	1,666,783	383,769
Electronics and communications	731,837	39,729	78,190	62,505	474,676	257,161
Other procurement	1,780,702	77,718	73,729	194,990	1,377,478	403,224
Undistributed	142,494	—	—	—	—	142,494
Total—Procurement	12,773,513	436,178	621,128	914,596	8,474,302	4,299,210
Research, Development, Test, & Evaluation						
Military sciences	220,035	9,401	8,875	26,030	214,165	5,870
Aircraft	447,091	20,198	32,423	26,437	386,531	60,560
Missiles	789,256	28,710	33,820	49,276	719,243	70,013
Astronautics	22,874	667	1,898	2,140	21,727	1,147
Ships	468,317	18,281	23,367	47,839	404,160	64,157
Ordnance, vehicles and related equipment	195,969	2,857	6,614	14,820	178,422	17,547
Other equipment	147,208	9,184	2,184	13,477	128,635	18,573
Program-wide management and support	675,721	43,758	30,640	129,396	645,141	30,580
Undistributed	3,698	—	—	—	—	3,698
Total—Research, Development, Test, & Evaluation	2,970,169	133,056	139,822	309,414	2,698,024	272,145
Military Construction	1,339,980	14,612	73,916	67,069	740,427	599,553
TOTAL—DEPARTMENT OF THE NAVY	30,027,174	1,747,794	1,790,475	2,595,726	24,831,500	5,195,673

Department of the Air Force

	Available for Obligation	Obligations April 1969	May 1969	June 1969	Cum thru 30 June 1969	Unobligated balance 30 June 1969
Military Personnel						
Active forces	6,138,031	477,579	493,196	486,190	6,131,634	6,397
Reserve forces	159,930	12,621	12,636	17,139	152,706	7,224
Total—Military Personnel	6,297,961	490,199	505,833	503,629	6,281,340	13,620
Operation and Maintenance	7,588,980	632,540	539,584	671,314	7,551,591	37,389
Procurement						
Aircraft	6,617,675	245,732	72,096	833,289	4,344,521	2,273,154
Missiles	2,087,242	160,049	126,769	198,509	1,465,631	621,611
Ships	—	—	—	—	—	-
Ordnance, vehicles and related equipment	1,918,337	100,109	25,345	102,016	1,631,876	286,461
Electronics and communications	705,053	18,605	46,720	76,401	389,256	315,797
Other procurement	477,883	27,796	17,138	27,216	406,567	71,316
Undistributed	230,747	—	—	—	—	230,747
Total—Procurement	12,036,937	552,295	288,469	1,237,460	8,237,852	3,799,085
Research, Development, Test, & Evaluation						
Military sciences	185,075	9,427	8,065	18,005	162,606	22,469
Aircraft	557,531	14,046	112,212	60,619	499,392	58,139
Missiles	1,117,395	96,958	62,376	80,562	1,093,615	23,780
Astronautics	1,217,337	55,120	74,997	64,723	1,193,588	53,749
Other equipment	103,595	51,178	25,183	49,617	347,265	56,330
Program-wide management and support	290,404	20,944	21,360	22,642	287,650	2,754
Undistributed	34,582	—	—	—	—	34,582
Total—Research, Development, Test & Evaluation	3,835,919	217,973	304,195	296,166	3,584,116	251,803
Military Construction	622,176	35,029	62,243	65,387	462,719	159,458
TOTAL—DEPARTMENT OF THE AIR FORCE	30,381,972	1,958,038	1,690,322	2,776,956	26,120,618	4,261,355

Defense Agencies/Office of the Secretary of Defense

Military Personnel						
Retired Pay	2,460,000	212,952	213,797	214,611	2,442,941	7,059
Operation and Maintenance	1,153,526	101,063	91,274	103,111	1,141,408	12,119
Procurement						
Ordnance, vehicles and related equipment	2,863	—10	9	15	2,157	706
Electronics and communications	9,997	3,170	61	1,240	7,932	2,065
Other procurement	94,130	1,227	13,249	11,770	55,302	39,128
Undistributed	21,998	—	-	—	-	24,998
Total—Procurement	132,288	4,387	13,320	13,051	65,391	66,897
Research, Development, Test, & Evaluation						
Military sciences	539,347	40,566	43,072	90,275	452,562	86,785
Emergency Fund	—	—	—	-	—	-
Undistributed	—	—	—	—	—	
Total—Research, Development, Test, & Evaluation	539,347	40,566	43,072	90,275	452,562	86,785
Military Construction	51,153	2,362	457	8,961	13,262	40,891
Family Housing	746,433	56,147	28,063	62,170	671,091	72,342
Other	15,742	22	111	37	580	15,162
TOTAL—DEFENSE AGENCIES/OSD	5,091,489	417,498	390,095	487,225	4,790,235	301,254

Office of Civil Defense

Civil Defense	69,205	2,216	4,084	9,580	64,353	4,852

Military Assistance

Military Personnel	90	—13	2	22	90	- -
Operation and Maintenance	520,092	17,398	104,623	124,910	458,661	61,431
Procurement						
Aircraft	38,301	1,177	—1,539	—2,770	38,301	—
Missiles	—4,715	—35	862	5,504	—4,715	
Ships	15,652	2,026	—88	4,800	15,652	-
Ordnance, vehicles and related equipment	67,471	—1,762	9,981	9,390	67,471	-
Electronics and communications	25,182	553	1,157	2,306	25,182	-
Other procurement	20,184	2,118	2,646	4,709	20,184	
Total—Procurement	162,075	4,077	13,019	12,931	162,075	- -
Research, Development, Test, & Evaluation	—36	—9	—	- -	—36	- -
Military Construction	71	—	—	538	71	- - -
Undistributed	—230	2	—9	—215	—230	-
TOTAL—MILITARY ASSISTANCE	682,061	21,455	117,636	138,187	620,631	61,431

NOTE: All outlay amounts are on a net Treasury basis (gross payments less reimbursement collections), whereas obligations and unpaid obligations are on a gross basis (inclusive of reimbursable activity performed by components of DOD for each other). Therefore, unpaid obligations as of the end of the reporting month cannot be computed from other figures in this report.

Prepared by:
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Office of Assistant Secretary of Defense (Comptroller)
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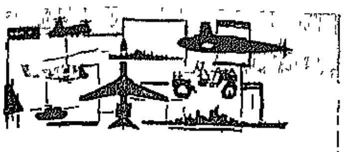

DEFENSE PROCUREMENT

acts of $1,000,000 and over
l during the month of October

NSE SUPPLY AGENCY

'r Fabricators, Inc., Grantsville, $2,046,855. 304,920 pneumatic nylon esses. Defense Personnel Support r, Philadelphia, Pa DSA 100-70-2

Products Corp., Raleigh, N C. $1,-'7. 85 rough terrain diesel fork lift s. Wake Forest, N.C. Defense Gen-Supply Center, Richmond, Va. DSA 0-C-1563.

on Textile Engineering and Manu-ring Co., Inc., Trenton, N.J. $1,053,-45,600 coated wet weather nylon twill s Trenton and Dover, Del. Defense nnel Support Center, Philadelphia, DSA 100-70-C-0673

lard Oil Co. of Calif., Western Opera-Inc., San Francisco, Calif. $4,904,-Fuel oil and gasoline for installations e Southwest. Defense Fuel Supply r, Alexandria, Va. DSA 600-70-D-

i's All American Sportswear, Inc., y, Miss. $1,130,049 446,660 pairs of polyester and wool tropical trousers. rent, Ala., and Hatley, Miss. Defense nnel Support Center, Philadelphia, DSA 100-70-C-0722.

d Industries, Inc., Watertown, N.J. 1,370. Snow blast sweepers. Defense ruction Supply Center, Columbus, DSA 700-70-C-8457.

ssi and Son Co., Vineland, N.J. 1,640. 146,040 men's tropical poly-'wool coats for the Air Force De-Personnel Support Center, Phila-ia, Pa. DSA 100-70-C-0735

le Dale, Inc., Atlantic City, N.J. 0,933. 133,350 men's wool serge ne Corps coats. Philadelphia, Pa. ise Personnel Support Center, Phila-ia, Pa. DSA 100-70-C-0773

i's All American Sportswear, Inc., ıry, Miss. $1,451,279. 1,210,460 pairs ıen's cotton sateen trousers for the ,. Guntown and Amory, Miss, and it, Ala Defense Personnel Support 'r, Philadelphia, Pa. DSA-100-70-C-

ral Foods Corp., White Plains, N.Y. 7,512. 3,046,000 units (900 grams) stant rice. Dover, Del. Defense Per-l Support Center, Philadelphia, Pa 130-70-C-M036

e Ben's, Inc., Houston, Tex. $1,645,-3,055,000 units of instant rice. De-Personnel Support Center, Phila-ia, Pa. DSA 130-70-C-M037.

er Fabricators, Inc., Grantsville, 1. $1,507,558. 225,160 pneumatic ı mattresses. Defense Personnel Sup-Center, Philadelphia, Pa. DSA 100--0632.

Manufacturing Co., Macon, Ga $1,-90. 417,000 linear yards of Army ı twill cloth. Macon and Columbus, and Salisbury, N.C. Defense Per-el Support Center, Philadelphia, Pa 100-70-C-0817.

CONTRACT LEGEND

act information is listed in 'ollowing sequence: Date—any — Value — Material or to be Performed—Location ›rk Performed (if other than ıny plant) — Contracting 'y—Contract Number.

30—Nantex-Riviera Corp., New York, N Y. $1,454,724 3,442,320 pairs of men's cotton drawers. Greenwood, S.C. Defense Personnel Support Center, Philadelphia, Pa DSA 100-70-C-0828.

31—Burlington Industries, Inc., New York, N Y $3,406,320. 912,000 linear yards of wool gabardine, Army Green. Raeford, N.C., and Halifax and Clarksville, Va. Defense Personnel Support Center, Philadelphia, Pa DSA-100-70-C-0784.

DEPARTMENT OF THE ARMY

1—Martin Marietta Corp., Orlando, Fla. $14,-720,131 FY 1970 industrial engineering services for the Pershing missile system. Army Missile Command, Huntsville, Ala. *DA-AH01-70-C-0216.*

—Cessna Aircraft Co., Wichita, Kan. $2,-240,000. High time maintenance and modernization of O-1A to O-1G aircraft. Army Aviation Systems Command, St. Louis, Mo. DA-23-204-AMC-04365(T).

2—Wilkinson Manufacturing Co., Fort Calhoun, Neb. $2,119,838. Metal parts for M524A5 fuzes (81mm mortar projectiles) Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0094.

—REDM Corp., Wayne, N.J. $1,740,778. Metal parts for 81mm mortar projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0095.

—Bulova Watch Co., Valley Stream, N J. $2,101,540. Metal parts for 81mm mortar projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0100

—McAdoo White Co., Inc., Riverside, Calif. $1,555,597. Restoration of 36 miles of the White Water River channel, Riverside County, Calif. Army Engineer District, Los Angeles, Calif. DA-CW09-70-C-0029.

3—Philco-Ford Corp., Newport Beach, Calif. $1,215,000. FY 1970 Chaparral research and development program. Army Missile Command, Huntsville, Ala. DA-AH01-70-C-0311.

—Healy Tibbits Construction Co., Honolulu, Hawaii. $1,046,542. Phase one rehabilitation of the Armed Forces Rest and Rehabilitation Center, Fort DeRussy, Honolulu. Army Engineer District, Honolulu, Hawaii DA-CA83-70-C-0006.

—Chamberlain Corp., Elmhurst, Ill. $9,027,-098 (contract modification). Production facilities for 155mm and 175mm projectile metal parts. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-36-034-AMC-0163(A).

6—National Presto Industries, Eau Claire, Wis. $3,315,025 (contract modification). Metal parts for 8-inch projectiles, M106. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0109.

—Fischback and Moore International Corp., SA, Dallas, Tex. $2,990,000. Construction of an electric power plant addition, Miraflores Power Plant, Fort Clayton, Canal Zone, Panama. Army Engineer District, Jacksonville, Fla. DA-CA70-70-C-0008.

—U.S. Steel Corp., Pittsburgh, Pa. $1,-584,600 (contract modification). Metal parts for 8-inch projectiles, M106. Berwick, Pa. Army Ammunition Procurement and Supply Agency, Joliet, Ill. *DA-AA09-69-C-0226.*

9—Insley Manufacturing Co., Indianapolis, Ind. $4,239,877. 20-ton commercial cranes, plus shovel fronts. Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-70-C-1994.

—Talley Industries, Inc., Mesa, Ariz. $1,-260,000. Metal parts for 4 2 inch illuminating projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0036.

10—Martin Marietta Corp., Orlando, Fla. $6,-766,000. Pershing missile component and power station research and development. Army Missile Command, Redstone Arsenal, Huntsville, Ala DA-AH01-70-C-0282.

—General Motors Corp., Indianapolis, Ind. $1,480,000 (contract modification). M109 155mm self-propelled howitzers. Cleveland, Ohio. Army Weapons Command, Rock Island Arsenal, Ill. DA-11-199-AMC-00610(W).

—The Frankford Arsenal, Philadelphia, Pa., awarded the following contracts:

Remington Arms Co., Inc., Bridgeport, Conn. $12,456,225. 7.62mm NATO cartridges. DA-AA25-70-C-0174. $5,605,-000. 5 56mm ball cartridges. DA-AA25-70-C-0171.

Olin Mathieson Chemical Corp., East Alton, Ill. $5,602,150. 5.56mm ball cartridges. DA-AA25-70-C-0162.

Federal Cartridge Corp., Anoka, Minn. $3,984,750. 5.56mm ball cartridges. DA-AA25-70-C-0161.

Wells Marine, Costa Mesa, Calif. $2,-745,300. M13 7.62mm machine gun belt links. DA-AA25-70-C-0177.

Jackes-Evans Manufacturing Co., St. Louis, Mo. $2,736,000. 7.62mm machine gun belt links. DA-AA25-70-C-0176.

Barry L. Miller Engineering, Hawthorne, Calif. $1,372,500. 7.62mm machine gun *belt links. DA-AA25-C-0170.*

George K. Garret Co., Philadelphia, Pa $1,259,000. 7.62mm machine gun belt links. DA-AA25-70-C-0179

—The Army Ammunition Procurement and Supply Agency, Joliet, Ill., issued the following contracts:

Amron Corp., Waukesha, Wis. $3,557,-338. 40mm cartridge cases. Waukesha and Antigo, Wis. DA-AA09-70-C-0128.

AVCO Corp., Richmond, Ind. $1,718,795. Metal parts for 40mm projectiles. DA-*AA09-70-C-0121.*

General Time Corp., La Salle, Ill. $2,-871,000. Metal parts for 2.75 inch rocket point detonating fuzes. DA-AA09-70-C-0064.

Bulova Watch Co., Jackson Heights, N.Y. $2,547,353. *Metal parts for 2.75 inch* rocket point detonating fuzes. Woodside, N.Y. DA-AA09-70-C-0065. *C-0107.*

AVCO Corp., Richmond, Ind. $1,344,-600. Metal parts for 2.75 inch rocket point detonating fuzes. DA-AA09-70-*C-0107.*

14—General Motors Corp., Detroit, Mich. $4,-232,906. Diesel engines for the M113 vehicle family. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-0012.

—Medico Industries, Inc., Wilkes Barre, P $2,415,000. Metal parts for high explosi warheads. Army Ammunition Procur ment and Supply Agency, Joliet, Ill. D AA09-70-C-0133

—Chamberlain Manufacturing Corp., Wate loo, Iowa $1,283,100. Metal parts f high explosive warheads. Army Ammun tion Procurement and Supply Agenc Joliet, Ill DA-AA09-70-C-0134.

15—Sylvania Electric Products, Inc., Mour View, Calif. $3,066,080 (contract m cation). Classified. Army Mobility ment Research and Development Fort Belvoir, Va. DA-AK02-68-(

16—Western Electric Co., New York, $3,399,500 (contract modification). search and development on the Sp. missile and the Perimeter Acqui Radar. McDonnell Douglas Corp., S Monica, Calif., General Electric Co., cuse, N.Y., and other subcontra DA-30-069-AMC-00333(Y). $8,8

(contract modification). Additional hardware for the Perimeter Acquisition Radar. Greensboro, N.C., Bell Telephone Labs, Whippany, N.J. and Lockheed Electronics, Los Angeles, Calif. DA-30-069-AMC-00333(Y). Safeguard System Command, Huntsville, Ala.
—Northrop Corp., Anaheim, Calif. $1,830,000. WDU4A/A warheads Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-AA09-70-C-0132
17—Amron Corp., Waukesha, Wis $1,094,800. 20mm brass cartridge cases. Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C-0202
—Olin Mathieson Chemical Corp., East Alton, Ill $2,694,400 60mm illuminating projectiles. Marion, Ill Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-AA09-70-C-0150.
—AVCO Corp., Stratford, Conn. $1,277,611 T-53 turbine engine nozzles. AF-41608-69-A-2421 $2,774,188. T-53 modification kits. AF-41608-69-A-2421. Army Aviation Systems Command, St. Louis, Mo
—Firestone Tire and Rubber Co., Akron, Ohio. $1,954,742. T-107 recovery vehicle track shoe assemblies. Noblesville, Ind. Army Tank Automotive Command, St Louis, Mo DA AE07-70-C-1651.
—Goodyear Tire and Rubber Co., Akron, Ohio. $1,058,681. T-132E1 self-propelled howitzer track shoe assemblies. St. Mary's, Ohio Army Tank Automotive Command, St. Louis, Mo DA-AE07-70-C-1978
—Ralph M. Parsons Co., Los Angeles, Calif. $3,673,818 (contract modification). Architectural engineering services for preparation of a standard design for the Missile Site Radar site Army Engineer Division, Huntsville, Ala. DA-CA87-68-C-0001.
—Ammann and Whitney, New York, N.Y. *$1,412,113 (contract modification)*. Architectural engineering services for preparation of a standard design for the Perimeter Acquisition Radar site. Army Engineer Division, Huntsville, Ala. DA-CA87-68-C-0011.
20—Kaiser Jeep Corp., Toledo, Ohio. $118,011,183 2½-ton M44 series trucks. South Bend, Ind. Project Manager, General Purpose Vehicles, Warren, Mich. DA-AE06-70-C-0001.
—Hercules Engines, Inc., Canton, Ohio. $37,472,224. LD 465-1C *multifuel engines* for the 2½-ton truck program, plus spares Army Tank Automotive Center, Warren, Mich. DA-AE07-70-C-1220
—General Dynamics Corp., Pomona, Calif. $11,081,522. Redeye missile warheads. Army Missile Command, Redstone Arsenal, Huntsville, Ala DA-AH01-70-C-0120
—AVCO Corp., Charleston, S.C. $4,650,000 (contract modification). Overhaul and or repair of T-53 L13/13A turbine engines. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-00308.
—S.J. Groves and Sons, Charleston, W.Va. $3,751,704 Relocation of W.Va. highway 37, East Lynn Lake Project Army Engineer District, Huntington, W.Va DA-CW69-70-C-0017.
—Ford Motor Co., Highland Park, Mich. $2,784,033. M151A1 ¼-ton utility trucks. Project Manager, General Purpose Vehicles, Warren, Mich. DA-AE06-70-C-0003
—Sanders Associates, Bedford, Mass. $1,175,183. AN/TTQ-34 prototype radar systems. Harry Diamond Laboratories, Washington, D.C. DA-AG39-69-C-0043.
21—Olin Mathieson Chemical Corp., East Alton, Ill. $26,068,420 (contract modification). Artillery and small arms ammunition propellants. Baraboo, Wis. Army Ammunition Procurement and Supply Agency, Joliet, Ill DA-AA09-69-C-0014
—Litton Systems Corp., Woodland Hills, Calif. $2,000,000. Test *equipment for* AN/ASN-86 inertial navigation systems Army Electronics Command, Fort Monmouth, N.J. DA-AB07-68-C-0345.
—The Picatinny Arsenal, Dover, N.J. awarded the following contracts for metal parts for 2.75 inch rocket motor fin and nozzle assemblies.
Jackson Products Co., Tampa, Fla. $3,372,000. DA-AA21-70-C-0213.
Muncie Gear Works, Muncie, Ind. $5,191,902. DA-AA21-70-C-0212.
HIPCO, Denver, Colo. $5,077,500. DA-AA21-70-C-0211.
The Marquardt Co., Ogden, Utah $4,851,000. Clearfield, Utah. DA-AA21-70-C-0210.
22—Bell Aerospace Corp., Fort Worth, Tex. $3,665,524. Drive shaft assemblies for UH-1 helicopters Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.
24—Computer Sciences Corp., Huntsville, Ala $1,169,970. Programming and maintenance of the Safeguard Management Information System. Safeguard System Command, Huntsville, Ala. DA-HC60-70-C-0034.
27—Sylvania Electric Products, Inc., Mountain View, Calif. $1,535,200. Research and development work in electronic warfare. Procurement Division, Army Electronics Command, Fort Monmouth, N.J. DA-AB07-68-A-0503.
—International Telephone and Telegraph Corp., Nutley, N.J. $3,939,960 (contract modification). Module sets for AN/GRC-144 radio set operating spares. Procurement Division, Army Electronics Command, Philadelphia, Pa. DA AB05-68 C 0027.
28—The Army Ammunition Procurement and Supply Agency, Joliet, Ill, awarded the following contracts.
Norris Industries, Inc., Los Angeles, Calif. $2,760,411. 105mm cartridge cases. Riverbank Army Ammunition Plant, Riverbank, Calif. DA-AA09-70-C-0167.
Norris Industries, Inc., Brockton, Mass. $2,866,498 (contract modification). 66mm rocket launchers. DA-AA09-69-C-0085.
Maxson Electronics Corp., Macon, Ga. $1,617,000. 60mm illuminating projectile assemblies. DA-AA09-70-C-0165.
ACF Industries, Inc., St. Louis, Mo. $2,640,460. Body assemblies for M525 mortar fuzes. DA-AA09-70-C-0149.
Olin Corp., East Alton, Ill. $1,378,569. Loading, assembling and packing M84A1 time fuzes. Marion, Ill. DA-AA09-70-C-0162.
29—The Army Ammunition Procurement and Supply Agency, Joliet, Ill., issued the following contracts
Honeywell, Inc., Hopkins, Minn. $1,460,494 (contract modification). PDM 551 fuzes. New Brighton, Minn. DA-AA09-70-C-0104.
Pace Corp., Memphis, Tenn. $1,276,411 (contract modification). White Star parachute signals. Camden, Ark., and *Memphis. DA-AA21-69-C-0519.*
National Presto Industries, Eau Claire, Wis. $1,430,675 (contract modification). Metal parts for 8-inch high explosive *projectiles. DA-AA09-69-C-0101.*
—General Motors Corp., Indianapolis, Ind. $2,908,800. T-63-A-700 engines for OH-58A helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-70-C-0329.
30—The Army Ammunition Procurement and Supply Agency, Joliet, Ill., issued the following contracts:
Day and Zimmerman, Inc., Philadelphia, Pa. $4,792,262 (contract modification). Loading, assembling and packing ammunition, and operation of Lone Star Army Ammunition Plant, Texarkana, Tex. DA-11-173-AMC-00114(A).
Sperry Rand Corp., New York, N.Y. $14,850,915 (contract modification). Loading, assembling and packing ammunition. Army Ammunition Plant, Shreveport, La. DA-11-173-AMC-00080(A).
Thiokol Chemical Corp., Bristol, Pa. $10,713,889 (contract modification). Loading, assembling and packing artillery ammunition. Longhorn Army Ammunition Plant, Marshall, Tex. DA-11-173-AMC-00200(A).
Action Manufacturing Co., Philadelphia, Pa. $1,242,800. Metal parts for rocket fuzes. DA-AA09-70-C-0178.
Ordnance Products, Inc., North East, Md. $1,304,948. Hand grenade fuzes. DA-AA09-70-C-0169.
—Hall Construction Co., Inc., Little Silver, N.J. $2,063,352. Construction of 100 family housing units, Fort Monmouth, N.J. Army Engineer District, New York, N.Y. DA-CA51-70-C-0029.
—Bell Helicopter Co., Fort Worth, Tex. $16,489,330 (contract modification). UH-1H helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-C-0028.
31—Dow Chemical Co., Midland, Mich. $2,678,000. Nose assemblies for M126 bombs. Madison, Ill Edgewood Arsenal, Md. DA-AA15-70-C-0191.
—Ordnance Products, Inc., North East, Md. $4,481,585. M18 colored smoke hand grenades. Edgewood Arsenal, Md. DA AA15-70-C-0110.
—E.I. Dupont de Nemours Co., Wilmington, Del. $1,323,000 (contract modification). TNT. Army Ammunition Plant, Newport, Ind. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA AA09-68-C-0114.
—National Presto Industries, Eau Claire, Wis. $2,373,290 (contract modification) Metal parts for 105mm high explosive projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA AA09-69-C-0028.
—S. Topfer and Sons, Inc., Deer Park, N.Y. $1,118,558. Metal parts for high-explosive warheads. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70 C-0176.
—ITT Corp., Nutley, N.J. $1,368,578 (contract modification). Engineering a change to AN/TRC-144 radio sets. Clifton, N.J. Procurement Division, Army Electronics Command, Philadelphia, Pa. DA AB05-68 C-0027.
—RCA, Burlington, Mass. $5,321,227. FY 1970 engineering services for the Land Combat Support System. DA AH01 70 C-0333. $10,442,248. Land Combat Support System hardware. Army Missile Command, Huntsville, Ala. DA AH01-70 C 0322
—Maremont Corp., Saco, Maine. $3,391,640. 7.62mm machineguns. Army Weapons Command, Rock Island, Ill. DA AF03-70-C 0027.
—Rohm and Haas Co., Philadelphia, Pa. $1,700,000. Propellant research program. Redstone Arsenal, Huntsville, Ala. Army Missile Command, Huntsville, Ala. DA-AH01-70-C-0146.
—AVCO Corp., Stratford, Conn. $3,600,000. T-55L-11 turbine engines for CH 47C helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-70 C 0321.
—Kaiser Jeep Corp., Toledo, Ohio. $114,915,178. 5-ton trucks, all body types. South Bend, Ind. Project Manager, General Purpose Vehicles, Warren, Mich. DA-AE06 69-C-0009.
—Western Electric Co., New York, N.Y. $27,041,244. Production engineering and long lead time component manufacturing Safeguard System Command, Huntsville, Ala. DA-HC60-68-C 0017.
—North Electric Co., Galion, Ohio. $1,481,971. 12 emergency action console switchboards. Procurement Division, Army Electronics Command, Philadelphia, Pa DA-AB05-70-C-3201.
—Western Electric Co., New York, N.Y. $4,331,000 (contract modification). FY 1970 Nike Hercules engineering services, Burlington, N.C., and Titusville, Fla. Army Missile Command, Huntsville, Ala. DA-AH01-68-C-0105.

DEPARTMENT OF THE NAVY

1—Honeywell, Inc., Minneapolis, Minn. $14,246,626. Rockeye bomb cluster components. N00019-70-C-0140. $3,012,500. Fuel-air-explosive weapon system. N00019-70-C-0176. Naval Air Systems Command, Washington, D.C.
—McDonnell Douglas Corp., Long Beach, Calif. $6,242,157. Triple and multiple bomb ejection racks. Torrance, Calif. Naval Air Systems Command, Washington, D.C. N00019-69-C-0681.
—Johns Hopkins University, Silver Spring, Md. $1,800,000. Increased level of effort for advanced research on surface missile system. Naval Ordnance Systems Com- [illegible] 0004 C.
2- [illegible], N.Y. [illegible] h and [illegible] Labs, Whippany, N.J. Naval Electronic Systems Command, Washington, D.C. N00030-70-C-3516.
3—Lockheed Aircraft Corp., Burbank, Calif. $10,000,000 (contract modification). Incre-

mental funding for the S-3A aircraft program. Naval Air Systems Command, Washington, D.C. N00019-69-C-0385.

—Westinghouse Electric Corp., Baltimore, Md. $2,470,000 (contract modification). Modification kits to incorporate a digital computer replacing existing analog types in AN/APG-59 radar systems. Naval Air Systems Command, Washington, D.C. N00019-69-C-0064.

6—Grumman Aerospace Corp., Bethpage, N.Y. $4,500,000 (contract modification). Long lead time effort and materials in support of F-14A aircraft procurement. Naval Air Systems Command, Washington, D.C. N00019-69-C-0422.

—McDonnell Douglas Corp., St. Louis, Mo. $3,300,000 (contract modification). Parts and equipment for Air Force F-4E aircraft. Naval Air Systems Command, Washington, D.C. N00019-68-C-0495.

—Williams Research Corp., Walled Lake, Mich. $1,048,057. J400-WR-400 engines for MQM-74A aerial targets. Naval Air Systems Command, Washington, D.C N00019-70-C-0116.

—Thiokol Chemical Corp., Elkton, Md. $1,439,000. Case and shroud forgings, special tooling and miscellaneous long lead time items for production of the Mk 67 Mod O rocket motor for the ZAP rocket. Naval Ordnance Labortory, White Oak, Md. N60021-70-C-0084.

—Lear-Siegler Inc., Grand Rapids, Mich. $1,188,587. Components for the AN/AJD3 bomb loft release computer set. Naval Aviation Supply Office, Philadelphia, Pa. N00383-A-5504-0643.

—M. Steinthal and Co., Inc., New York, N.Y. $1,170,654. Mk 28 Mod 1, Mk 34 Mod 0, Mk 36 Mod 0 and Mk 37 Mod 0 parachute packs. Roxboro, N.C. Naval Ordnance Station, Louisville, Ky. N00197 70-C-0166.

8—General Electric Co., Schenectady, N.Y. $20,626,000. Nuclear reactor comartment components. Naval Ship Systems Command, Washington, D.C. N00024-69 C-5154.

—General Electric Co., Utica, N.Y. $17,-244,682. Guidance and control groups for the Chaparral missile. Naval Air Systems Command, Washington, D.C. N00019-70-C-0088.

—The Naval Ordnance Systems Command, Washington, D.C, issued the following contracts:

FMC Corp., Minneapolis, Minn. $7,151,-878. 5-inch 54-caliber gun mounts, Mk 45 Mod 0. N00017-68-C-4211.

General Dynamics, Pomona, Calif. $2,-445,000 and $1,272,576. Supplies and services to investigate Terrier, Tartar and Standard missile performance. N00017-69-C 2209 Mods P001 and P002.

9—Hughes Aircraft Co., Culver City, Calif. $6,500,000 (contract modification). Incremental funding for the Phoenix missile program. Naval Air Systems Command, Washington, D.C. N00019-67-C-0240.

—Singer-General Precision, Inc., Silver Spring, Md. $3,064,554. 14B40 radar/MAD multi-station trainers for use at fleet airborne electronics units. Naval Training Device Center, Orlando, Fla. N61339-69-C-0075.

—The Johns Hopkins University, Silver Spring, Md. $4,951,000. Advanced classified research on surface missile systems. Naval Ordnance Systems Command, Washington, D.C. NOw 62-0604-c.

—Loral Corp., New York, N.Y. $1,018,500. Spare parts for maintenance and overhaul of AN/ALQ-78 electronic countermeasure equipment in P-3C aircraft. Naval Aviation Supply Office, Philadelphia, Pa.

13—Sanders Associates, Nashua, N.H. $14,-748,472. Research, development and production of AN/ALQ-100 countermeasures sets. Naval Air Systems Command, Washington, D.C. N00019-70-C-0105.

—United Aircraft Corp., East Hartford, Conn. $2,439,000 (contract modification). Product support engineering services for T34, TF33/JT3D, J-57/JT3D and J-75/JT4 engines for the Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0367.

—Lockheed Aircraft Service Co., Ontario, Calif. $2,405,400. Modification of C-130A aircraft to DC-130 configuration. Naval Air Systems Command, Washington, D.C. N00019-70-C-0182.

14—Aluminum Co. of America, Pittsburgh, Pa. $15,544,084. Aluminum powder. Rockdale, Tex., New Kinsington, Pa., and Alcoa, Tenn. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-70-C-A047.

—United Aircraft Corp., Stratford, Conn. $3,685,536. Component parts for the dynamic drive system of CH-53A aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-69-A-3900-0950.

15—General Electric Co., Schenectady, N.Y. $48,950,000 (contract modification). Designing and furnishing nuclear propulsion components. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5154 Mod. 8.

16—Northwest Marine Iron Works, Portland, Ore. $13,468,000. Conversion of the troop transport VC2-S-AP5 (ex-USS Sherburne, APA-205) to a Fleet Ballistic Tracking Ship (T-AGM-22). Swan Island, Ore. Naval Ship Systems Command, Washington, D.C. N00024-70-C-0224.

—McDonnell Douglas Corp., St. Louis, Mo. $1,000,000 (contract modification). Weapons dispensing, separation and jettison testing on F-4E aircraft. Naval Air Systems Command, Washington, D.C. N00019-70 A-0015.

20—Singer-Precision, Inc., Little Falls, N.J. $2,639,293. Spare parts for doppler radar systems for P-3C aircraft Pleasantville, N.Y. Naval Aviation Supply Office, Philadelphia, Pa. N00383-68-3201-0181.

21—Sparton Corp., Jackson, Mich. $6,366,330 (contract modification). FY 1970 funding for AN/SSQ-53 sonobuoys. Jackson, Mich., and Deland, Fla. Naval Air Systems Command, Washington, D.C. N00019-69-C-0465.

22—American Manufacturing Co. of Texas, Fort Worth, Tex. $3,376,044. Mk 41 Mod 0 5-inch 54-caliber projectiles. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-70-C-A008.

—Texas Instruments, Inc., Dallas, Tex. $2,-886,120. Spare parts for AN/APS 115 radar systems for P-3C aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-69-A-1801-0148.

—McDonnell Douglas Corp., Long Beach, Calif. $1,538,005. Design, develop, fabricate and furnish graphite composite primary structural components for aircraft wingtype applications. Naval Air Engineering Center, Philadelphia, Pa. N00156-70-C-1321.

—North American Rockwell Corp., Anaheim, Calif. $7,278,684. Refurbishment and modification of Navy Ships Inertial Navigation Systems. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5009.

—Sperry Rand Corp., Charlottesville, Va. $1,982,916. Small craft and amphibious vehicle gyrocompass systems. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5226.

—Philco-Ford Corp., Fort Washington, Pa. $1,181,476. Engineering and technical services in the training of Navy personnel in the operation of communication, radar and sonar equipment. Naval Ship System Command, Washington, D.C. N00024-70-C-1077.

23—Hughes Tool Co., Culver City, Calif. $1,-546,809 Replacement parts for the Mk 4 20mm gunpod. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-67-A-0009-0232.

24—Northrop Corp., Palos Verdes, Calif. $23,-518,000. Development of the Joint Services In-Flight Data Transmission System (JIFDATS). Naval Air Systems Command, Washington, D.C. N00019-70-C-0195.

27—Straightline Manufacturing Co., Cornwells Heights, Pa. $8,226,088. Mk 82 Mod 1 bomb fin assemblies. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00107-70-C-A023.

—General Dynamics Corp., Pomona, Calif. $3,495,000. Procurement of materials for Standard missile production. Naval Ordnance Systems Command, Washington, D.C. N00017-67-C-2107.

—Leland Stanford Jr. University, Stanford, Calif. $1,235,000. Research and technology for the Nuclear Physics, Physical Sciences Division, Office of Naval Research, Office of Naval Research, Washington, D.C.

28—The Naval Air Systems Command, Washington, D.C., awarded the following contracts:

Grumann Aerospace Corp., Bethpage, N.Y. $11,300,000 (contract modification) Long lead time and materials for the EA-6B aircraft program. N00019-67-C-0078. $9,000,000 (contract modification). Long lead time and material to support planned FY 1970 KA-6D aircraft program. N00019-68-C-0106.

Hughes Aircraft Co., Culver City, Calif. $5,350,000. AN/AWG-9 airborne missile control systems. Culver City, Los Angeles, Canoga Park, and El Segundo, Calif., and Tucson, Ariz. N00019-70-C-0207.

LTV Aerospace Corp., Dallas, Tex. $1,000,000 (contract modification). Flight demonstration program of JP-5 fueled, air-launched low-volume ramjet propulsion system. N00019-68-C-0605.

—Hercules, Inc., Wilmington, Del. $1,105,-000. Solid propellant rocketry research. Cumberland, Md. Naval Ordnance Systems Command, Washington, D.C. N00017-70-C-4413.

—Raytheon Co., Lexington, Mass. $6,498,-027. Electronic equipment. Bristol, Tenn. Naval Ordnance Systems Command, Washington, D.C. N00017-70-C-1405.

29—General Dynamics Corp., Groton, Conn. $8,850,000 (contract modification). Overhaul, refueling, and C-3 Poseidon missile conversion of the USS James Madison (SSBN 627). Naval Ship Systems Command, Washington, D.C. N00024-68-C-0256 PZ12.

—Bell Aerosystems Co., Buffalo, N.Y. $2,-563,623. Aircraft carrier landing-control central trainers. Wheatfield, N.Y. Naval Ship Systems Command, Washington, D.C. N00024-70-C-1229.

—The Naval Air Systems Command, Washington, D.C., issued the following contracts:

Grumann Aerospace Corp., Bethpage, N.Y. $9,516,738 (contract modification). EA-6B aircraft. N0019-67-C-0078.

United Aircraft Corp., East Hartford, Conn. $1,567,255. Fabrication of XJ-52-P-408 and YJ-52-P-408 aircraft engines. N00019-70-C-0070.

Stromberg Datagraphic, Inc., San Diego, Calif. $6,115,500. AN/ASA-70 tactical display groups. N00019-70-C-0101.

Sundstrand Corp., Rockford, Ill. $1,-401,274. Constant speed drives for A-7E aircraft. N00019-68-C-0088.

30—General Electric Co., Utica, N.Y. $12,-961,902. AN/AYA-8 data processing system for P-3C aircraft. Naval Air Systems Command, Washington, D.C. N00019-70-C-0124.

—Johns Hopkins University, Silver Spring, Md. $21,641,900. Advanced research on the Surface Missile System. Naval Ordnance Systems Command, Washington, D.C. NOw 62-0604.

—*United Aircraft Corp., Stratford, Conn.* $2,750,000 (contract modification). Long lead time effort and material for procurement of Air Force CH-53C helicopters. Naval Air Systems Command, Washington, D.C. N00019-69-C-0621.

DEPARTMENT OF THE AIR FORCE

1—Mitre Corp., Bedford, Mass. $23,688,676 Research and development of advanced information and communications systems Electronic Systems Division, AFSC, L.G Hanscom Field, Mass. F19628-68-C-0365

—Continental Aviation and Engineering Corp., Detroit, Mich. $3,262,124. Production of J-69-T-29 aircraft engines. Toledo Ohio. Aeronautical Systems Division AFSC, Wright-Patterson AFB, Ohio F33657-70-C-0039.

—Western Electric Co., New York, N.Y. $1,156,901. Engineer, furnish and install communications system for the telemetry data center, Air Force Western Test Range, Vandenburg AFB, Calif. New York, Kearney, N.J. and Vandenburg AFB. Air Force Western Test Range Hq., AFSC, Vandenburg AFB, Calif. F04697-70-C-0062.

—Cutler Hammer Inc., Deer Park, N.Y. $8,124,647. Ground radar sets (AN/TPX-42), spare parts and change kits. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0207.

—Holmes and Narver, Inc., Los Angeles, Calif. $1,835,820. Continuation of maintenance and operation of the Naval Research Site, Point Barrow, Alaska. Hq., Alaskan Air Command, Elmendorf AFB, Alaska. F65517-69-C-0001.

2—Republic Electronic Industries, Inc., Melville, N.Y. $1,571,260. Airborne navigational aids (RT-471). Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1334.

—Northrop Corp., Norwood, Mass. $1,642,370. Gyrocompasses for Minuteman III guidance and control units. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0235.

—McDonnell Douglas Corp., Tulsa, Okla $1,154,216. Modification of and production of component parts for A-1E aircraft. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-70-C-0220.

3—Dynamics Corp. of America, Bridgeport, Conn. $2,680,653. Production of MB-16 diesel generator sets. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-68-0575.

—Lockheed Aircraft Corp., Marietta, Ga. $6,190,193. Spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF33(657)-15053.

—ITT Technical Services, Inc., Paramus, N.J. $1,520,761 (contract modification). Maintenance and operation of Air Force Plant No. 42, Palmdale, Calif. Air Force Flight Test Center, Edwards AFB, Calif. F04611-68-C-0001.

—Philco-Ford Corp., Fort Washington, Pa. $1,797,874. Engineer, furnish and install a seven station, six link tropospheric scatter and line of sight communications system in Greece. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-70-C-0965.

6—North American Rockwell Corp., Anaheim, Calif. $3,504,000. Engineering effort on Minuteman II. Space and Missile Systems Organization, Los Angeles, Calif. AF04-(694-786).

—Baifield Industries, Carrollton, Tex. $3,163,711. Production of bomb fin assemblies for 750-pound bombs. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-0268.

—F and M Systems Co., Dallas, Tex. $1,923,000. Production of a teletype data multiplexer addresser system Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-70-C-0760.

—Dynalectron Corp., Fort Worth, Tex. $1,224,235. Modification of C-130 type aircraft. Naha AB, Okinawa. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-D-4415.

7—General Electric Co., Philadelphia, Pa. $1,300,000. Research and development of the Mk 12 reentry vehicle. Space and Missile Organization, AFSC, Los Angeles, Calif. AF04(694)-976.

8—Collins Radio Co., Dallas, Tex. $1,190,000. Communications electronics systems for an Air Force Satellite Control Facility. Richardson, Tex. Space and Missile Systems Organization, Los Angeles, Calif. F04695-67-C-0137.

—Lockheed Aircraft Service Co., Jamaica, N.Y. $6,663,785. Inspect and repair as necessary C-121 type aircraft. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-70-C-0131.

9—The Ogden Air Materiel Area, AFLC, Hill AFB, Utah, issued the following contracts for SUU-30 bomb dispensers:

Crescent Precision Products, Inc., Garland, Tex. $3,056,420. F42600-70-C-0608.

Batesville Manufacturing Co., Camden, Ark. $2,244,130. F42600-70-C-0624.

American Electric, Inc., LaMirada, Calif. $3,759,258. F04606-69-A-0166.

—Wolverine Diesel Power Co., Detroit, Mich. $2,144,904. Diesel generator sets. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-70-D-0039.

10—Lockheed-Georgia Co., Marietta, Ga. $81,768,723. Production of 53 C-5A aircraft, run A. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33-(657)-15053.

—Honeywell, Inc., Hopkins, Minn. $1,589,910. Component parts for antipersonnel munitions. St. Louis Park, Minn. Armament Development and Test Center, AFSC, Elgin AFB, Fla. F08635-70-A-0029.

13—North American Rockwell Corp., Columbus, Ohio. $3,629,000. Electro-optical guided bomb kits. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0336.

14—LTV Electrosystems, Inc., Greeneville, Tex. $2,100,000. Design, fabrication and test of ground data reduction systems (GS-3030). Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C00415.

15—IBM Corp., Gaithersburg, Md. $1,335,060. Engineering services leading to development of improved comupter programming techniques for specialized data handling. Various DOD installations. Rome Air Development Center, AFSC, Griffis AFB, N.Y. F30602-70-C-0066.

—Texas Instruments, Inc., Dallas, Tex. $6,397,079. Bomb guidance kits. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0254.

—Whittaker Corp., Gardena, Calif. $1,268,854. Bomb racks and modification kits. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0434.

—Superior Steel Ball Co., New Britain, Conn. $2,969,400. Component parts for air munitions. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-0055.

16—AVCO Corp., Wilmington, Mass. $1,100,000. Development and flight test of advanced penetration aids. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0289.

—Victor Comptometer Corp., Rogers, Ark. $1,150,800. Production of component parts for air munitions. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-0652.

17—Curtiss-Wright Corp., Wood Ridge, N.J. $7,123,200. Overhaul of KC-135 and F-101 aircraft engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-70-D-1101.

20—Lockheed-Georgia Co., Marietta, Ga. $14,066,505. Spare parts for C-5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF 33(657) 15053.

—Austin-Wright Construction Co., Inc., Oklahoma City, Okla. $4,050,000. Construction of 226 family housing units, Mountain Home AFB, Idaho. Procurement Division, Mountain Home AFB, Idaho. F10603-70-C-0028.

—FWD Corp., Clintonville, Wis. $3,062,800. Firefighting trucks. Warner Robins AFB, Ga. F09603-69-C-0074.

—General Motors Corp., Indianapolis, Ind. $1,999,998. Spare blade assemblies for C-130A/D aircraft. Warner Robins AFB, Ga. F34601-69-A-2021.

—Kilgore Corp., Toone, Tenn. $1,375,000. Target markers. Armament Development and Test Center, Eglin AFB, Fla. F08635-70-C-0002.

—Litton Systems Inc., Woodland Hills, Calif. $3,195,950. Inertial navigational systems component parts and related aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0295.

21—Continental Aviation and Engineering Corp., Detroit, Mich. $2,839,050. J-69 engines and spare parts for T-29 aircraft. Toledo, Ohio. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0127.

—Lockheed Aircraft Corp., Sunnyvale, Calif. $1,119,868. Research on reentry vehicles. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0157

22—American Electric Inc., LaMirada, Calif. $9,234,104. Production of 500-lb. bombs. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-0728.

23—Honeywell, Inc., Hopkins, Minn. $4,725,000. Production of air munitions. St. Louis Park, Minn. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-0650.

—Hayes International Corp., Birmingham, Ala. $3,912,417. Inspection and repair as necessary, maintenance and wing structure modification of C-124 aircraft. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-69-C-0029.

—The Boeing Co., Wichita, Kan. $1,602,231. Depot level maintenance of B-52 aircraft. Oklahoma City Air Materiel Area, Tinker AFB, Okla. F34601-69-C-3987.

—Curtiss-Wright Corp., Caldwell, N.J. $1,269,282. Overhaul of propeller assemblies for C-124 and C-133 aircraft, and T-34 test cells. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-70-D-0632.

—The Aeronautical Systems Division, AFSC Wright-Patterson AFB, Ohio, issued the following contracts:

General Electric Co., West Lynn, Mass. $4,583,400. J-85-GE-4 and T-64-GE-411 engines. F33657-69-C-1214.

Sylvania Electronic Systems, Needham Heights, Mass. $2,021,418. Portable multi-channel radios. F33657-70-C-0495

Singer-General Precision, Inc., Pleasantville, N.Y. $1,159,900. Aerospace ground equipment for airborne radio navigational aids. F33657-68-C-0924.

24—Hayes International Corp., Birmingham Ala. $4,475,837. Inspection and repair as necessary, maintenance and modification of C-130 aircraft. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-70-C-0793.

—Gibbs Die Casting Aluminum Corp., Henderson, Ky. $1,033,337. Component parts for munitions. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-70-C-0660.

—AVCO Corp., Wilmington, Mass. $1,952,000. Design and flight testing of reentry vehicles and penetration aids launchers in support of the anti-ballistic missile defense program. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0278.

27—TRW Inc., Redondo Beach, Calif. $2,650,000. Systems engineering and technical direction in support of Hard Rock Silo development program. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0210.

28—The Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio, awarded the following contracts:

Honeywell Inc., St. Petersburg, Fla. $3,400,000. Development of an advanced aircraft navigation system. F33615-70-C-1044.

General Electric Co., Evandale, Ohio. $30,000,000. C-5A aircraft engines. AF33(657)15003.

FED Sign and Signal Corp., Aircraft Equipment Co., Miami, Fla. $3,315,170. Maintenance platforms, spare parts and aerospace ground equipment for the C-5A aircraft. AF33657-70-C-0412.

—Mitre Corp., Bedford, Mass. $3,712,000. Research and development of advanced information and communication systems Electronic Systems Division, AFSC, L.G. Hanscom Field, Mass. F19628-68-C-0365.

—Radiation Inc., Melbourne, Fla. $4,890,000. Research and development of airborne electronic equipment. Palm Bay, Fla. Electronic Systems Division, AFSC, L.G. Hanscom Field, Mass. F19628-70-C-0005.

29—North American Rockwell Corp., Anaheim, Calif. $1,894,650. Guidance and control systems for the Minuteman III system. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF 04(694)-904.

—McDonnell Douglas Corp., St. Louis, Mo. $2,037,000. Electronic countermeasure pod suspension kits for F-4 series aircraft. Roberston, Mo. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F34601-69-A-2245.

—Westinghouse Electric Corp., Baltimore, Md. $17,200,223. Airborne countermeasure equipment. Aeronautical System Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0440.

30—General Motors Corp., Indianapolis, Ind. $3,922,927. Engineering effort to improve the component parts of the T-56 engine. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F3365-69-C-0794.

—Collins Radio Co., Cedar Rapids, Iowa. $1,225,008. ARC-105 UHF transceiver systems and data. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-70-C-0046.

—Sundstrand Corp., Rockford Ill. $4,557,000. Constant speed drives and gear boxes for aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-68-A-2298.

—Wall Colmonoy Corp., San Antonio, Tex.

$1,532,124. Repair of component parts of aircraft jet engines. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F41608-69-D-0623.

—Computer Sciences Corp., El Segundo Calif. $4,306,395. Development, installation, operation, test and maintenance of equipment to improve the capability of the space track system. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-69-C-0503.

31—Honeywell Inc., Tampa, Fla. $2,506,664. Multiplexer sets, AN/UCC-4, and associated spare parts. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-70-C-1405.

—Raytheon Co., Waltham, Mass. $1,628,000. Electron tubes for AN/ALT-28 airborne electronic countermeasures equipment. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-69-C-3150.

—North American Rockwell Inc., Anaheim, Calif. $1,490,915. Spare parts and data in support of Minuteman III weapon system. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F04701-68-C-0174.

OFF-SHORE PROCUREMENT

16—Canadian Commercial Corp., Washington, D.C. $5,465,070. Interservice depot level maintenance of T-39 aircraft. Northwest Industries, Ltd., Winnipeg, Manitoba, Canada. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-70-C-0230.

Mobile Missile Trackers Sought by Army

Performance characteristics for the development of a Mobile Target Tracking System (MTTS), prepared by the Combat Developments Command (CDC), Fort Belvoir, Va., have been approved by the Department of the Army.

MTTS was conceived to provide mobile air-transportable tracking stations for missile ranges lacking facilities for support of research, development tests, evaluation and training flights of target missiles.

Completely mobile, via standard Army trucks or transport aircraft, the system would provide launch, inflight operation and recovery control over all missiles now in the Army plus those being developed for future use.

CDC requirements call for line-of-sight control over missiles over a range up to 120 nautical miles and 40,000 feet, with range accuracies of plus or minus 100 yards. Close-in control would be to a minimum of 300 feet above terrain level at 12 nautical miles, without ancillary equipment.

Total weight of the receiver, transmitter, antenna and digital subsystem would be 5,000 pounds or less. Reliability would be 80 percent per mission—from launch to recovery—barring destruction by the air defense missile. Mission duration capability calls for a minimum 30 minutes.

Logistics Service Center

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Battle Creek, Mich. 49016, or call (616) 962-6511, extension 6601.

Surplus Sales

One of the better known services of interest to industry provided by DLSC is the DOD surplus sales program.

Improved supply management materiel utilization efforts have in large measure attributed to the decline in the percentage of usable items sold during the past few years. From a taxpayer's point of view, this is a good trend. DLSC still operates a big business and continues to sell hundreds of millions of dollars worth of desirable surplus industrial type items. Most of the center's product line is industrial in nature. Therefore, the majority of over 30,000 active buyers on the DLSC mailing list are commercial and industrial buyers.

Many buyers are using items once thought purely military in nature to help them produce commercial products. For example, high-speed tractors are in demand by utility companies because of their high flotation characteristics. They are used for ditching, to lay pipelines, and to clear marshlands.

Surplus electronic gear is sold not only as consumer items, but as industrial products. Surplus chemicals are used in the chemical processing industry. Marine items, including vessels, are used on the inland waterways.

One of the desirable aspects of buying government surplus items is that normally no salesman will call. However, once DLSC market researchers determine a need for an outlet or identify a marketing target, a personal sales approach may be utilized. This is known as our "Knock On The Door Policy." For the most part, however, DLSC's marketing communications involve direct mail in the form of sales catalogs and, occasionally, special brochures and flyers. After a company is entered on the DLSC mailing list, its purchasing agent will be apprised of only those items that the company needs to produce its product or service. DLSC surplus property customers are not burdened with extraneous mailings.

To receive pertinent information, simply notify the Director of Marketing, Defense Logistics Supply Center, P.O. Box 1370, Battle Creek, Mich. 49016, that you are interested in bidding on DOD surplus materiel, or call (616) 962-6511, extension 6701. A brochure delineating the over 523 classes of property sold by DLSC, primarily through 10 sales offices, will be mailed to you. Included in this package will be an application form that will enable you to indicate, by code number, the kinds of items you are interested in and the geographical area in which you are willing to travel to inspect the materiel. Your completed application will be programmed into the DLSC computer and, when items in which you have expressed an interest become available for sale, you will be automatically mailed an invitation for bid.

Practically all merchandise is sold on a competitive basis of some form, using either the sealed bid, spot bid, or auction method. Under special circumstances and unusual conditions, certain items may be sold by negotiation. The majority of the hundreds of millions of dollars worth of items are sold using the sealed bid method. Therefore, in most cases, a potential buyer does not have to be present to bid. We do encourage prospective bidders to inspect materiel before bidding.

In summary, DLSC's services of interest to industry are continous, are increasing, and they are varied. All of them are designed to enhance supply efficiency and reduce costs—a concern of the Government and private sector.

Changing Address?

When requesting a change in address or cancelling a subscription, readers must send the mailing label from the back cover of the magazine. Without this label, changes cannot be made in the computerized list. Do not alter or deface the label.

Allow two months for change of address to be effected.

The new address and old label should be sent to: Editor, Defense Industry Bulletin, Defense Supply Agency, Room 4A 508, Cameron Station, Alexandria, Va. 22314.

Defense Industry Bulletin
Defense Supply Agency (DSAH-B)
Cameron Station, Alexandria, Va. 22314

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When requesting address change, send this mailing label. Do not alter or deface.

Air Force Develops Television Reconnaissance Viewfinder System

The Air Force is developing a television viewfinder system for reconnaissance aircraft to replace the old style "light pipe," or optical viewfinder.

The system consists of four components:

- Instrument panel mounted control indicator.
- Downward-looking television camera with a 15mm lens and a 40-degree field of view.
- Forward-looking camera with a 15-150mm zoom lens and a variable field of view from 5 to 48 degrees.
- Power supply synchronizer.

The viewfinder has video tape recording capability, but no recorder has been chosen.

More flexible than the optical viewfinder, the new system does not require any structural changes in the aircraft. The viewfinder system provides the pilot with a display of the fields of view of his film cameras to assist in locating, identifying and photographing desired targets. Effective altitude range of the system is from 500 to 20,000 feet. Field of view coverage is from seven degrees below the horizon to five degrees behind the nadir.

Originated by the Air Force Systems Command's Aeronautical Systems Division (ASD), Wright-Patterson AFB, Ohio, for use in the RF-101 Voodoo aircraft, the system is also being considered for other applications. Prototypes of the viewfinder were produced by Fairchild Space and Defense Systems, Paramus, N.J.

Preliminary tests at the Tactical Air Reconnaissance Center, Shaw AFB, S.C., have shown that the display can be viewed from any normal head position in the cockpit, an advantage over the optical tube system which required the pilot to be looking down into an eye-lens device.

C. F. Weis, of the ASD Directorate of Reconnaissance Engineer-ng's Optronics Branch, is project manager.

New Computerized Systems Being Placed in DSA Centers

The Defense Supply Agen (DSA) is placing a new co puterized materiel manageme system in operation to give supply centers increased cap bility. The new Standard Aut mated Materiel Manageme System (SAMM) has been i stalled and is operational at t Defense Construction Supp Center, Columbus, Ohio.

Centers scheduled to recei SAMMS installations duri 1970: Defense Industrial Su ply Center, Philadelphia, Pa Defense General Supply Cente Richmond, Va.; Defense Ele tronics Supply Center, Dayto Ohio; and Defense Personn Support Center, Philadelphi Pa.

SAMMS is a uniform syste designed to perform major ma teriel management function such as processing, require ments computation, pricin cataloging, provisioning, pro curement, financial managemen and reporting.

The system was designe programmed and tested by DSA Data Systems Automation Offic Columbus, Ohio.

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